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The Portage Lake Mining District, with its Sloping Terraces and Thrown Veins.*

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It is not my intention in this article to consider this subject in the light of the geographer or geologist, but rather in that of the mining engineer, and to endeavor to show the necessity and value to him of studying the minor details of the field or district in which he may be engaged. It has been said by a distinguished geologist that "the natural boundaries of the geographer are rarely described by right lines. Whenever they occur, however, the geologist may look for something remarkable." And again: "Physiognomy is no idle or doubtful science in connection with geology. The physiognomy of a country indicates almost invariably its geological character."

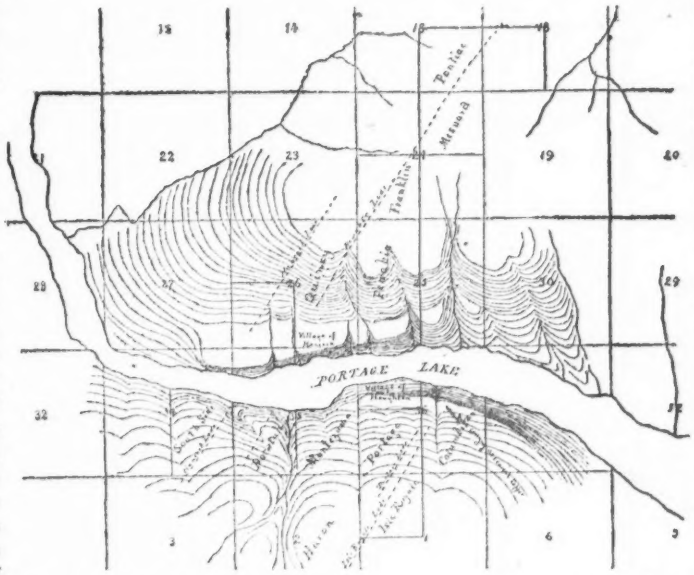
Our country furnishes examples enough of the truth of these remarks, and in no part of it is it so beautifully illustrated as in our own State, and which has been so ably described by Prof. Lesley in his admirable little work on the "Topography of Coal."

As the great mountain lines become guides to the geologist in determining and mapping out the geography of the formations, so do the minor details of topography become guides to the mining engineer in conducting his explorations, discovering of dislocations, and determining the character of the deposits which are the object of his search. It is therefore requisite that he should, whilst making his surveys, pay the strictest attention to every variation of the landscape and surface of the ground. Until he has mapped out every feature, he may be unable to read the geological changes which may have passed under his view. In particular, he should note all sudden changes in the course of streams, any prominent knolls of ground, and the different angles of slopes of the hills, as they often tell the direction of the dip of the rocks even though the rocks may not be visible. Knolls, forming with each other regular lines, mostly denote the presence of a hard stratum of rock, the character of which it may be valuable to know. The exact mapping of such knolls is necessary to the discovery of displacements in the strata, in a region where fracture veins are found; and on the contrary, should such displacement in the line of knolls or outcropping of a belt be found, then it is a sure indication that such fracture veins do exist. It is hardly necessary to give in detail the many results to be derived from an accurate noting of every natural feature. We may feel sure, however, that there is a natural reason for the existence of every such feature just where it is found—a reason why the stream runs on one side of the valley and not the other; why it is rapid at one point and gentle in another, and why the hill is steep on one side and slopes smoothly away in the opposite direction.

* A paper read before the American Institute of Mining Engineers.

In illustration of these assertions, I wish to draw attention to a field in which I have been more especially engaged, and to the topography of which I have devoted more or less study, viz: The Lake Superior copper region.

The Lake Superior Copper Region has in accordance with the centres of mining industry, been divided geographically and politically into three sections, namely: "The Point," "Portage," and "Ontonagon" districts, situated respectively in Keweenaw, Houghton and Ontonagon counties, and although the districts are situated on the same continuous mineral range, they are separated by large comparatively unexplored territories. This division into three sections is by no means accidental, but is the result of the topographical features of the region, as indicated both by its geography and the character of its mineral deposits.



In the first section or district you have natural harbors in the very edge of the mineral range; in the second the range is intersected by a lake which affords transportation directly to the mines; and in the third the mouth of the river, which drains the district, has been made the common commercial centre.

Upon examination the topography of the range and character of the deposits will be found equally various.

The main features of the coast line of Lake Superior is the great point projecting far out into it from the southern shore. This is the mountain ridge of copper-bearing trap, which has withstood the action of the forces that have worn away the sandstones around it. The conspicuous points of this great headland are Mounts Houghton and Bohemian, peaks of the southernmost of the two ridges, which in this section (The Point) constitute the mineral range. These two peaks, with the ridge connecting them, are a great mass of porphyry, and around them on the north the trap range sweeps with a nearly regular curve from the northeast, where the strata have a bearing of about S. 60 degrees E. and north 60 degrees W., to the northwest, where they have a bearing of about N. 30 degrees E. and S. 30 degrees W. This latter course is maintained on through the Portage District, and with slight variations on through the Ontonagon District.

In the Point District, the greenstone strata is the most conspicuous belt among the traps, and presents a splendid escarpment towards the south of many miles in length. Its excessive hardness has enabled it to resist the forces which have worn off the other beds, and it is now the great landmark of the explorer. It is a base line from which he measures and numbers the other belts to the north and south.

A careful mapping of this ridge, together with its accompanying and underlying conglomerate, enables the engineer to detect the great displacing fractures which cross the whole range. They seem to possess an approximate parallelism, having a nearly north and south bearing, and as the other veins are displaced by them, belong therefore to the most recent class. They have formed the gorges in the ridge, through which the streams have found their way, and afford easy passage for the roadways. Besides these main fissures you find every few hundred feet other veins of a different class and material. many of these scarcely show themselves in the greenstone ledge, but are much more prominent in the softer strata and an accurate tracing of these ledges will often detect their presence and displacements. These are divisible into main or mother lodes, which have a bearing more or less radial to the southern porphyritic mountains, and branch lodes which have their begining and ending in the main lodes.

This, therefore, becomes the distinguishing feature of the Point District, namely, the fracture veins intersecting the stratification at nearly right angles, in which receptacles have been collected to a greater or less extent the objects of the miner's search. Not all of these fractures contain metallic deposits, or at least in remunerative quantities, and it is a question for the most careful study of the mining engineer to determine, not only by the examination of the mineral contents, but also by the topography of the ground, whether these veins cannot be so classified as to be able at once to know the class to which each one belongs, and therefore approximate to its value. Such an examination will also determine the relative ages of the class, and therefore the comparative method or process of filling, valuable data for the mineralogist. I think it may now be safely asserted that the latest made veins of fracture are those which have caused the gaps of the main ridge, and further, that they are for mining purposes valueless.

In order, however, to study these questions in all their bearings, it is necessary to look at the adjoining districts.

In the second or "Portage" district, the features

of the country are entirely charged. The greenstone ridge has sunk down to the general level of the other strata, or perhaps has disappeared, and the summit of the mineral range is comparatively regular and level. The range is marked by no prominent feature, either of elevation, ravine, or change of course, until the deep gorge occupied by Portage Lake is encountered. The explorations in this section, up to the present time, have discovered but few fissure veins, and those only in the immediate vicinity of Portage Lake. No doubt others will be found, but sufficient examinations have been made to prove that they are but few and far between, and further that they belong to the most recent class, and, as asserted above, are to the miner of no value. The workable metallic deposits of this section are the strata themselves, and we are therefore led to infer that the fissures in the "Point" section have there robbed the strata to such an extent as to make them, with local exceptions, comparatively valueless. This point being ascertained, namely, that the metallic deposits in the fissure veins came directly from the enclosing strata, supplies the geologist with a groundwork for his reasoning as to its original source.

If we now examine closely the gorge of Portage Lake we will find that its topography opens up other questions of great interest. It intersects the range on a nearly east and west line, the ridge rising on the north side to an elevation of 600 to 650 feet, and on the south side to about 500 feet. The whole slope of the mountain on the north side is covered with the deep deposits of the Drift period. This has been furrowed with deep ravines by the streams which now and formerly ran down the face of the hill. The opposite mountain side has been scoured clean by the current which must have set through the gorge, leaving the rocks with scarce soil enough for vegetation. The gorge, after passing through the main range in either direction, has a bearing nearly north and south, and it is interesting to follow the hillsides, and notice where the force of the current has either left the rocks bare or allowed the deposition of debris,

About 50 feet above the present level of the lake in the town sites of Hancock and Houghton, the ancient shores of the lake are distinctly visible as terraces, extending on the north side from about the middle of section 27 near two miles to the middle of section 25, where the ravines of the mountain side have made it no longer traceable, and on the south side, from the Dacotah creek eastward to the east side of section 31, about 2½ miles. The terrace on the north side is higher than on the south (but I cannot now give the difference in elevation), an evidence that a great fracture exists under the bed of the lake. They are not horizontal, as they must of necessity have been at one time, but rise very perceptibly towards the east, an evidence that the mountain range has been subject to some elevating power at a comparatively recent geological period. On the eastern half of section 36, on the south side of the lake, the terrace changes its line of grade, it rising from that point eastward faster than its descent toward the west. This change of grade is a proof of some local disturbance beneath, and it was to me for a long while a subject of conjecture what it could mean. Finally, some few hundred feet from this point of change in grade a dyke was opened which carries arsenical copper in considerable quantities, and upon examining the course of it I found it to intersect this point in the terrace.

This change of grade is not noticeable on the northern terrace, from the fact that it is too much cut up by the ravines to be traceable at the point where the course of the dyke would intersect it. The dyke may not have extended so far, but the fact that some arsenical ore was once found in explorations near the top of the north hill, would lead us to conjecture that it did extend for a long distance in that direction, and if so, it would probably pass between the Franklin and Mesnard mines.

The great main fracture of the range, which exists under the bed of the lake, would most likely be accompanied by minor ones, near at hand, and these we find on the hillsides, cutting through the Quincy, Hancock and Sheldon-Columbian mines. These belong undoubtedly also to the most recent class of veins, and have so far proved worthless.

You will thus perceive that the study of the topography of these terraces becomes a valuable element to the engineer in this district.

After proceeding to the southwest from Portage Lake about seven or eight miles, we enter into a comparatively unexplored region, which extends a distance of — miles before we reach the real Ontonagon District. This unexplored section, if we may judge from the irregularity of the hills—only here and there appearing to form range lines—is very much disturbed beneath and much broken by heavy faults.

In the Ontonagon District, there are a number of wide and deep passes in the range, through which flow the rivers Fire Steel, Flint Steel and Ontonagon, unwatering the country lying to the south. An examination of these mountain ridge *blocks*—if I may so designate them—between the passes, will show that at the northeast end of the blocks the strata have a much flatter dip than at the southwest end. Therefore, if we trace a belt towards the southwest we will, in descending the southwest end of the hill, have to make an offset to the left to find the continuation of the belt on the southwest side of the gap.

This, as it were, oblique elevation has apparently been the cause of the mixed character of the deposits of this district, since both strata and fissure lodes have been found workable. The fissures, however, do not, as in the Point District, intersect the strata at right angles, but obliquely, and seem more the result of the warping of the strata in the blocks into which the ridge has been broken. The most conspicuous and best known example is that of the section between the Flint Steel and Ontonagon river gaps.

At the north or Flint Steel end of the mountain the rocks dip at an angle of 20° to 25° to the north and increase gradually until at the south or National Mine and they have attained to 50° to 60°.

Any sliding motion between the strata which would take place during the elevation would be apt to be along the smooth surface of the sedimentary or conglomerate and sandstone beds, hence the great contact or conglomerate lode, which produced the famous Minnesota mine.

The process of warping of the more rigid beds of trap was most likely the cause of the oblique fracture known as the North Minnesota lode.

We can easily illustrate this whole case, by taking hold of the leaves of an open book by one corner and raising them slightly, the lenticular openings between the leaves will then represent the receptacle or lodes. Viewing the subject in this light, caused me in the year 1859, after having made a close examination of the mine, to express the opinion that they were fast approaching the limits of the deposit, although the mine was then making its largest returns. The end came even sooner than I had expected.

I have now given the leading features in the topography above and below ground, of the three sections or districts, and have endeavored to show the cause of the variety in the nature of the deposits. In the first we have a series of fissure veins, resulting from the elevating force, being apparently a central and local one; in the second, it seems to have been a uniform raising of the range as a whole, therefore causing no fractures; and in the third, to have been a moving force traversing the range obliquely.

These speculations may be vague and very imperfect, but at the same time may form a sufficient basis upon which to build others when the region has been better explored, and affords more data with which to supply the deficiency. I might enlarge upon the subject by pointing out some interesting local features of the drift deposits and the elevations and dislocations which took place before and after these deposits, but that would lead me away from my subject, which was to point out the value to the mining engineer of neglecting nothing whilst doing the *preliminary* work in new ground, namely, making the surveys.

On the Importance of Surveying in Geology.

BY BENJAMIN SMITH LYMAN.*

THE importance of topography to geology is so commonly underrated as to deserve to be pointed out again and again. The relation of topography to the different branches of geology may be seen best by a glance at them all.

Geology is well understood to consist of the observation of facts about rocks as materials of the earth (geognosy) and the explanation of those facts (geogeny).

The facts to observe are :

I. GEOMETRICAL, as (1) *structure*, including the dip and strike at different points, the size, shape and position of basins and saddles; (2) *vertical section*, that is, the thickness of rock groups and of their parts; (3) *horizontal* or geographical *position*.

II. PHYSICAL, such as *texture*, whether sedimentary or crystalline; and, if crystalline, whether granitic, porphyritic, amygdaloidal, globular or concretionary; whether *compact or granular; coarse or fine; pervious or impervious; hard or soft; firm or tender; with cleavage or without; massive or thin; the microscopic structure; also whether magnetic or not; soluble or insoluble; fusible or infusible;* and the *constituent minerals*.

III. CHEMICAL, that is, the composition of the rocks and of their minerals and their affinities.

IV. PALEONTOLOGICAL, as what kind of fossils are in the rocks, whether (1) *salt-water;* and if so, whether (a) deep water; (b) shallow water; or (c) lagoon; (2) *fresh-water;* or (3) *land*.

Knowledge of this general character about the fossils is all that is needed of them for geological purposes, for understanding the nature of the rocks and the successive changes the earth has undergone. The special fossils that may be found in different beds of rock may be of great interest in the history of life in the world or of organisms (paleontology), and may sometimes give more or less trustworthy aid in determining practically the relative age of such beds. But in general it is rather the position of the beds, that determines the relative age of the different groups of animals or plants whose remains are found in them; and geology gives to paleontology far more in value than it gets in return. It is absurd, then, for paleontology to assume to be geology or the chief part of geology, as so often happens nowadays. Paleontology in truth only helps to a knowledge of a very few of the many physical and chemical facts about the earth's materials, and those few perhaps seldom of very great importance. The explanation of the changes from bed to bed in the general character of the fossils, as salt-water, fresh-water or land, deep water or shallow water fossils, depends, of course, on physical or chemical laws.

The facts that were just now called geometrical are of course in one sense merely physical; for they only concern the size, shape, position and general composition of rocks or groups of rocks. The explanation of such facts must always be of a physical or chemical nature.

It is plain, then, that both the facts of geology and their explanation are always either physical or chemical, with the not very important exception that the general character of fossils is shown by physiology.

The facts learned by measurement, though they can scarcely be separated wholly from the other classes of facts do not yield to them in importance.

* (Read before the American Institute of Mining Engineers, 22d Feb., 1872.)

The questions where a rock of a given physical or chemical nature is found, what is its extent and what is its position relative to other rocks and to the sea level, are at least as important as the physical and chemical facts themselves, both in theoretical geology and in practical mining. Indeed, the geometrical facts of themselves would sometimes show some of the most important physical facts; as, for example, the shape of the surface of the ground very often shows the relative hardness of the rocks that underlie it, and in a limited region show by that means what beds of a known series underlie given points, such as a coal bed marked at its outcrop by a terrace, or a hard bed of rock marked by a ridge. For a thorough understanding of geology of course an intimate acquaintance with the laws of physics and chemistry would be needed; but for most practical and even theoretical purposes only that common knowledge of them is wanted which almost every man has, and geometrical measurements become the sole and all important requirement.

The necessity of some sort of geometrical representation of some of the most important geological facts has been acknowledged almost universally by the use of maps and of more or less rudely made sections. But it is perhaps the very imperfection of such methods, as have been commonly employed, that has brought this branch of geological work into the undeserved contempt in which it seems generally to lie; and such geometrical representation has at best almost always been used solely to set forth geological facts, seldom as a means of finding them out. Very often, indeed, the map is merely to show the geographical distribution of different groups of fossil animals and plants. Even when hills or mountains are shown, it is only by vague shading or indefinite hachure lines with all traces of geological structure left out. The cross section, with its exaggerated vertical scale and distorted dips, would commonly seem rather to impress the eye with the varying height of surface than to show how the rocks lie, the true aim of a geological section. The map and section not only give the geological facts so very imperfectly, but are almost useless as an aid in working out the geology from the bare, disconnected facts observed in the field, and in correcting or verifying the guesses made there.

A geological map should be a geometrical construction on paper of the earth's features on the surface and below, and should show as fully as possible the shape of the surface, marked with the places of the observed rocks, and should give the position of the rocks, or of some of the chief beds of rock below the surface as well as on it; and should be accompanied by a section to show the thickness and sequence of the rock beds, as well as by a cross section of the region to show the dips and basins of the rocks.

The relative position of points on the ground is found, of course, by the measurement of horizontal distances and angles; the height of points is found by levelling, that is, the measurement of vertical distances. The points of reference on the surface are well enough mapped by any of the ordinary methods, but the shape of the surface is far better shown by contour lines (or lines of equal height) than by hachures (lines of greatest steepness) or shading (dark according to the steepness). Where the map is on a large scale, the contour lines may be ten feet apart in level, or even less, and show many details. But even in maps of large regions on a small scale, contour lines, although 100, or as much as 250 feet apart in level, or even more, so that many details must be left out, still give very much more information than hachures or shading, and show, roughly at least, the height of mountains, besides their course and steepness; and on comparatively level ground, where hachures and shading have nothing whatever to say, contour lines show not only the height, but the direction of the slopes and their steepness.

Shading aims only to show the steepness of the ground, and at the very best can do this only very roughly indeed. Hachures aim to show the steepness and its direction; but can show the steepness no better than shading, and to show well even the direction of greatest steepness, would often need far greater delicacy of touch and of eye than either is capable of. Neither shading nor hachures give even a rough idea of the relative height of the ground at different points. Contour lines, on the other hand, show with more or less exactness the height of every point on the surface, besides giving with great nicety both the direction of greatest steepness and its amount. There is indeed no comparison between the merits of contour lines and those of either of the other two methods; and the only plausible explanation of the fact that contour lines are comparatively so seldom used is that they are definite in their statements, they expect for their preparation a more definite knowledge of the shape of the ground, or at least a clearer idea of it, and consequently greater labor. Shading and hachures furnish a vague language that is fitted for expressing with ease vague information; what contour lines tell they tell with precision. If the information at hand be imperfect, contour lines will still express with clearness the best opinion, or guess that can be given by the map maker, whose guess even may be of great value to those who have not had his means of forming an opinion. The uncertainty of the information should at the same time be shown by the wording of the title of the map, or by a note upon it, or by dotting the contour lines. Indeed any desired degree of vagueness can be given by leaving the distance apart of the contour lines, indefinite, or only more or less approximately uniform. The advantage of contour lines over hachuring has been well insisted on in Lesley's "Manual of Coal and its Topography, 1856," but cannot be urged too often, until it is generally acknowledged and they come into common use.

It is very easy to give the appearance of relief to the map by thickening the contour lines, on one side of the hills, and by altogether leaving out half of them on the other side, so that the hills may look as if they were lighted by the sun on one side and in the shade on the other. But some confusion might arise in reading the map, because this very effect of dark shade is also given by the mere closeness of the contour lines which marks steepness of the ground. A dark shaded part may seem steeper than it really is, and a really steep place on the sunny side of a hill may from the omission of half the contour lines seem only half as steep as it is. It is, perhaps, better to give the relief effect by mere shading, heavy shading on one side of the hills and light shading or none at all on the other side, leaving the contour lines of uniform thickness to show the steepness of the ground by their closeness. Confusion would especially be guarded against by making the contour lines of a different color from the shading.

As contour lines give the best means of showing on paper the shape of the surface of the ground, so they give likewise the best means of showing on paper the shape of the surface of a bed of rock. It is seldom that the surface of a bed of rock is laid bare for any great distance by nature so that it can be mapped like the surface of the ground; but it often happens that this can be done in mines. In other cases it is necessary to map the bed and draw its contour lines with more or less certainty from the exposures that happen to be visible. Not only may the actual exposures of the bed itself be regarded, but as the beds above and below are more or less exactly parallel, its position can be reckoned from an observation of theirs. At each point of observation the strike and dip of the rocks must be taken as well as their level, just as in making observations for mapping the surface of the ground; besides taking the level of a point, the contour lines near it are at least sketched, that is, the direction of a level line, and the steepness at right angles with it are more or less exactly taken. If such observations on the rocks are made at points enough, a perfect geometrical representation of any bed of rock can be made. Even if the observations are too few for that, they may yet be enough to form a reasonable conjecture as to the position of the bed, with more or less uncertainty. The very putting down on paper with precision, in proper relation, what is known of the position of the rocks aids immensely in completing a geometrical construction of them, and gives a vast deal of information beyond what can be guessed at in the field. The eye takes in readily such mapped observations and sees their bearing upon each other, when the biggest head, with the same facts, but without a map, would be at fault and merely muddled.

The known or conjectured shape of the surface of the bed can be shown on paper better by contour lines than in any other way, and is generally so much more regular than the shape of the surface of the ground that the contour lines of one will not be mistaken for those of the other, even if they be drawn in the same color on the same sheet; and sometimes even several different beds may be drawn without confusion. The points where the contour lines of the bed meet the same contour lines of the surface, show the position of the outcrop of the bed, one of the most important features to map, whether for practical or for theoretical purposes. It is, in fact, the geometrical construction itself, that commonly shows the position of the outcrop through most of its length, very often where it would not otherwise be suspected.

If the dips are very steep it will often not be well to make the contour lines of a rock bed (the underground contour lines) as near together in level as those of the surface; they may be a hundred feet apart in level instead of ten, and yet show perfectly well the shape of the bed. Sometimes it is shown very well merely by the outcrop and a single contour line, that, for example, of the drainage level of the region, or the course that a drift for drainage would take on the bed in question. With surface contour lines and underground contour lines, the depth of the bed below the surface at any point can readily be known; and this is highly important in sinking a shaft or reckoning the yield of a bed above a given level.

With such a complete geometrical representation of the shape of a bed as contour lines would give, it is only needful to make a full section of all the beds with their thickness to show the position of every bed of rock at every point. The thickness of each bed in its order must be measured, of course, at right angles with its surface; and a drawing of the whole series made to show them all on the same scale. It is plain that the whole series need not be measured at one point, but the different parts can be taken wherever exposed. The geometrical construction of the map will help very much to show their relation, and the gaps between them, if any.

Having the surface of the ground and that of one or more rock beds shown by contour lines, and a section of all the rock beds with their thickness, it is easy to draw a cross section of the country in any direction, so as to show the profile outline of the ground and of each bed. Such a section across the average strike of the rocks or across the axes of their basins and saddles is especially useful; the next most useful section is commonly one along the axis of a basin. Of course the vertical and horizontal scale of such a section must be the same, otherwise the rock structure, the chief object of the section, would be greatly distorted. In making an undistorted cross section before the underground contours are drawn, facts often come to light that would otherwise be unknown, such as the identification of beds exposed only at distant points, and the steepness of the dip at points where there is no exposure. Sections of this kind are, therefore, often a very great help in making the map itself.

Such maps and sections, then, show completely all that is known (or conjectured) of the geometrical facts of the beds of rock, the thickness, extent, position and present shape of each bed, its position with

reference to each of the other beds; the shape, size, and position of the basins and saddles, what part of each bed still remains underground and what part has been worn away to form valleys, what part is above the lowest drainage level of the region or any other given level and what below it; and the very process of making the maps and sections is a very valuable aid to gaining such knowledge, and often teaches as much as could be learned by very costly digging or mining. These facts are not only of the highest importance themselves, but they lie at the base of very much (if not most) reasoning towards the explanation of the purely physical and chemical facts of rock beds.

Simple and clear as all this seems, yet it was so long overlooked and is still so much disregarded, that maps showing with the least completeness the geometrical facts of the surface and of the rock beds were never seen thirty-five years ago, and are extremely rare even now. Pennsylvania, in fact, can claim for itself or for its citizens, the credit of doing nearly all that has been done for the progress of this branch of geology, whose early history (in America at least) is but part of that of the Pennsylvania State Geological Survey, and whose later history is found in the geological work of the chief topographer of this survey, Professor J. P. LESLEY, followed by that of others who have learned more or less directly from him. To him alone, in fact, belongs the credit of almost all the advances that have been made in this line of work, as well as of having first estalished its most essential principles. Some of its earlier hitherto unpublished annals, learned by inquiry of him, deserve to be recorded before it is too late.

The Pennsylvania Survey under Professor H. D. ROGERS began in the year 1836, and soon discovered a very intimate relation between the surface features and the structure of the rock beds below, a relation that is perhaps more striking in this State and Virginia than in most countries.

Early in the Spring of 1839 one of the assistants of the survey, JAMES D. WHELPLEY, finished in lead pencil at the end of two years' work, all his own, the first topographical map. It embraced all the anthracite region except the Wyoming Valley.

In 1840 ALEXANDER MCKINLEY finished a sketch map of the Wyoming Basin.

Between the Spring of 1839 and Fall of 1840 ANDREW A. HENDERSON (now Surgeon in the United States Navy) made a beautiful map of the Juniata Region, partly copied into Lesley's "Manual of Coal and its Topography" (page 137.) At the same time the country north of that was also mapped by MCKINLEY.

In 1839 J. P. LESLEY, who had just joined the survey, made in Whelpley's style a map of the country south of the anthracite region and north of the North (or Kittatinny) Mountains.

In 1840 and 1841, Lesley was occupied in completing Whelpley and McKinley's maps by putting in the surrounding country.

At the end of 1841 all the materials of the whole State where any mapping had been done went into Lesley's hands, and in 1841 and 1842 he made up the State map and its cross sections.

In all these maps no contour lines were used, but great attention was paid to elevation for the cross sections, and the maps were made with the sections before the eye as a guide in making the hachures, and Dr. HENDERSON was especially successful in this.

In the winter of 1846 and 1847, LESLEY made a second copy of the State map and of all the sections across the State.

In 1851 he made a great map of the Shamokin anthracite region for Mr. ROGERS, a private undertaking. The country was crossbarred with section lines staked at short intervals; and the map was made with hachures on a peculiar system of Lesley's invention equivalent to contour lines.

In 1852 Lesley spent the summer in the field in making (for the State survey again) a great sheet of the Pottsville anthracite region. The country above ground was cross-barred with lines three-quarters of a mile apart, and the outcrops were run by parties under charge of JOHN SHEAFER; while underground surveys were also made by parties under P. W. SHEAFER, and LESLEY did the mapping. Contours were drawn only to determine the depth of the hachures, which were all short, showing the slopes, with eight or ten systems on a single mountain side. The outcrops in the gaps were marked by a peculiar system of hachures that showed the dip. Every outcrop of every coal bed and every rock outcrop were laid down. The map was between twenty and thirty feet long, and has gone out of sight, but no doubt still exists among the papers left by ROGERS at his death, since the State law made all the materials of the survey his private property.

At the end of 1852 it was finished only from near Donaldson and Tremont to within six or seven miles of Tamaqua, and embraced the Mine Hill basin and the plateau of the Broad Mountain. It was intended to carry forward and finish the map the next year; but the corps was broken up, and 1853 A. A. DALSON with one assistant was employed to extend the sheets. Without parties he could not do it in the same way, and ROGERS had him make out of all the materials extant the reduced copy of the map of the anthracite region (with hachures), published in the State Report under Lesley's and Dalson's names; but LESLEY never saw it until it had been printed. It should be called Dalson's map, as the preface to the Report does call it.

This and the great map of the State with its cross sections, are all that was ever published of all this work.

The first contouring for geological maps was done in 1853 and 1854, in a great map of LESLEY'S for the Pennsylvania Railroad Company, of the country from Johnstown to Greensburg, in Western Pennsylvania, covering parts of Westmoreland, Fayette and Indiana counties. It was eight feet long and four feet wide, and was covered with fine contour lines twenty feet apart in level, and with intermediate ten foot lines for relief, and shading on the south-east side of the hills. I myself saw this map about 1856 or 1857, and can bear witness that it was a very wonder of topographical labor and skill. It would seem years ago to have disappeared from existence, but it is incredible that so valuable a piece of work should be destroyed.

In 1855 and 1856 LESLEY mapped Broad Top Mountain with contour lines; and the survey was so minute that there were over eleven thousand stations leveled. None of this has ever been published, and it would be an extremely valuable contribution to another State survey.

In 1856 he published his "Manual of Coal and its Topography," in which he set forth most admirably the relations of topography to geology, and made public the principles of the art to which he himself had first given form. The book contains many beautiful little topographical maps and sketches by way of illustration. From that time to the present (owing partly to the increased ease of reproducing maps by the help of photography and photolithography), he has published many specimens of his work, especially in the Proceedings and Transactions of the American Philosophical Society, as well as in the pamphlets of private owners of mineral lands; and much remains unpublished. The maps cover many points in the Appalachian region from Cape Breton to Georgia, but particularly in Pennsylvania, and are sometimes in contour lines, with or without shading in addition, sometimes only in shading. The position of beds (say, of coal or iron) is shown on them by laying down their out crop and the course of a level upon the bed, for example the lowest water level of the tract or region. The maps are sometimes colored and sometimes not. They show not only very great topographical and geological knowledge and experience, but high artistic taste and skill.

In 1866 and 1867, the feasibility of using underground contour lines, to give the shape of rock beds (sometimes of three or four above one another), was proved on some Southwestern Virginia coal, iron and lead maps of my own; a photograph of one of which was shown to the meeting of the American Association for the Advancement of Science, in 1867, at Burlington. A number of such maps have been made since that, but the only printed ones are in my "Report on the Punjab Oil Lands, Lahore, 1870." They were all drawn with special reference to the requirements of photography.

In the last three years, and especially within the last year, contour lines have come a little more generally into use for geological purposes, no doubt solely through LESLEY'S example and teaching. R. P. ROTHWELL, J. W. HARDEN, S. F. EMMONS, A. HAGUE, T. B. BROOKS, J. F. BLANDY, and perhaps others, have published good works of this kind; not all of them, however, marking the position of the beds of rock even by an out-crop line, still less by a level.

Lengthening and Shortening of Undulations.

THE following interesting and ingenious method of demonstrating how waves which are in perfect unison may be thrown out of unison by a comparatively slow movement of one of the vibrating media which produce the waves, is the invention of Prof. A. M. MAYER, of the Stevens Institute of Technology.

In the case of a sound wave—moving 1,100 feet a second whatever the wave length—if the length be diminished more vibrations enter the ear in the same time and the pitch rises; if it be increased, less vibrations enter, and the pitch lowers. Light waves are strictly analogous; whenever any one of the colored waves which form white light, is lengthened its color changes toward the red end of the spectrum; when it is shortened, toward the violet. Hence, change of pitch in the case of sound, or of color in the case of light is evidence of motion, either to or from the observer; which it is, depends on whether the wave is lengthened or shortened. Now, while the motion of a star at right angles to the line of sight is easily detected and measured by the telescope, motion in the direction of this line is capable of measurement only by the spectroscope; if the motion be diagonal, then by both of these instruments together. Hence the motion of a fixed star in space, or of a whirlwind on the sun, may be measured by the change in refrangibility, which certain lines in the spectrum undergo.

To illustrate this point by means of sound waves, was the object of the evening. With the lantern, the image of a tuning fork beating 256 times a second—and giving the note Ut_3—was thrown on the screen. By the side of one of the prongs, and just touching it, was a carefully rounded and varnished cork ball, suspended by a filament of silk. On sounding a second fork, placed on its case and tuned in accurate unison with the first anywhere in the room, even 30 feet distant, the first was thrown into vibration and the image of the cork ball was projected a foot or two away from the prong. When, however, the second fork was sounded, and the lecturer walked rapidly—at a rate of 8 feet a second—towards or from the first, touching the case only when in motion, no motion of the cork was observed; the wave being in this way shortened or lengthened by an amount sufficient to throw it out of unison with the lantern fork. Again, a third fork, vibrating 254 times a second, produced no effect on the ball; but when sounded and placed on its case as this was swung rapidly toward the first fork, the wave length was thereby so shortened as to bring it into unison with this, and the ball promptly responded. A fourth fork, vibrating 258 times, showed the same phenomenon, when placed on its case as this was swung away from the first fork, the wave thus being lengthened into unison. The demonstration was most complete and satisfactory. Prof. MAYER will shortly make some quantitative experiments with the apparatus, which will be of the highest value to science.

THE COAL TRADE.

Anthracite Coals.

NEW YORK, March 22, 1872.

WHOLESALE.—The principal news in the coal trade during the past week has been the announcement of the consolidation of the Delaware, Lackawanna and Western railway company with the New Jersey Central, to which allusion was made in our last issue. What effect this union will have upon the future of the coal trade, it is very difficult to predict. The immediate consequences are not likely to be very seriously felt, but it is hoped that they will tend to an advance on the present prices of coal. The ulterior objects of the consolidation are not yet apparent, and considerable curiosity is manifested as to whether the consolidation will spread, so as to embrace other companies, or whether it will remain where it is, leaving competing lines from other coal fields.

Some dealers seem to be of opinion that the spirit of monopoly will spread, so that in a short time there will virtually be no competition in the trade at all.

The general feeling in the market seems to be that prices will be higher next month than they have been. A large number of orders for eastern shipment are on the books of the dealers in Trinity Building, awaiting the lower rates of freight, which are confidently expected, and the presence of vessels to carry the coal. We are informed that no less than eight vessels loaded with coal were wrecked off Cape Cod during a single week, and if such a fearful mortality is to continue among colliers, the total extinction of this class of vessels would appear imminent. As it is, vessels continue exceedingly scarce, and the prevailing rates are somewhat higher than they were last week. The prices for Pittston coal to contractors were fixed on the 20th instant. The shipments during the coming month are to be made from Newburgh and the prices are 20 cents per ton less than when shipments were made from Weehawken. They are, Lump $3.80, Steamer $3.80, Grate $3.95, Egg $4.05, Stove $4.30 and Chestnut $3.80, but the freight from Newburgh is 70 cents, against 50 cents from Weehawken, so that the price will be in reality the same. The river has been open to Newburgh, but the cold weather during the past week has closed it again temporarily, but the closure, of course, cannot be of long duration at this season.

Bituminous Coals

There is no change to note in these coals during the past week. The canal to Georgetown has been opened, but no coal has yet been received by the Consolidation company. Freights from Baltimore are somewhat lower than at our last writing.

Freights.

Rates from Elizabethport and Port Johnston are higher than those quoted in our last issue. We quote Boston $2.75 but vessels are not plenty at that rate.

Anthracite Coal Trade for 1871 and 1872.

The following table exhibits the quantity of Anthracite Coal passing over the following routes of transportation for the week ending Mar. 16, 1872, compared with the week ending Mar. 18, 1871.

COMPANIES.	1871. WEEK.	1871. TOTAL.	1872. WEEK.	1872. TOTAL.
*Phila & Reading R.R†	19,291	670,929	79,927	874,531
Schuylkill Canal	....	....	....	....
*Lehigh Valley R. R.	6,847	373,716	60,184	776,078
Lehigh & Sus. R. R.	1,589	67,128	35,207	275,790
Lehigh Canal	....	....	....	....
Scranton North	....	3,521	11,444	136,039
" South	....	137	38,722	406,040
Penn. Coal Co., rail	233	3,242	19,966	191,093
" " " canal	....	....	....	....
Del. & Hud. Canal Co.	....	....	....	....
" " East	....	48,332	16,082	119,681
" " West	....	12,741	5,876	79,923
" " South	....	....	5,698	69,751
Shamokin	7,025	88,522	7,940	70,118
Trevorton	....	....	....	....
Lykens Valley Coal Co.	....	10,916	....	2,580
Wyoming South	....	....	....	....
Wyoming North	....	....	....	....
P. N. Y. C. & R. R. Co.	63	34,331	9,880	141,450
Williamstown Co'y	....	17,847	....	....
Big Lick Col	2,029	15,342	....	10,591
Total	37,074	1,315,813	291,926	3,159,566
1870	....	....	37,074	1,345,813
Decrease				
Increase			253,852	1,813,753

* These figures are for the week and fiscal period commencing Nov. 30

† Less coal transported for Co's use and Bituminous coal.

Pennsylvania Coal Company.

Shipments of Pittston Coal for the week ending March 16, 1872.

	1872. WEEK.	1872. YEAR.	1871. WEEK.	1871. YEAR
By Railway	19,963 04	191,093 02	233 01	3,241 11
" Canal				
Total	19,966 02	191,093 02	233 01	3,241 11
Increase 1872	187,761 11			

Bituminous Coal Trade, 1871 and 1872.

The following table exhibits the quantity of Bituminous Coal passing over the following routes of Transportation for the week ending March 16, 1872, compared with week ending March 18, 1871.

COMPANIES.	1871. Week.	1871. Year.	1872. Week.	1872. Year.
C. & O. Canal	14,318	19,728	193	414
B. & O. R. R.	26,454	168,837	19,280	200,075
H. & B. T. R. R.	8,183	57,205	6,803	59,711
*Harrisburg & D.	10,493	89,810	10,311	137,954
*L. V. R. R.	7,250	12,734	730	8,413
P. & N.Y.C. & R. Co.	4,391	60,541	6,233	81,710
Cumberl'd Branch Canal	....	.....	....	.....
" Railroad	....	.....	....	.....
Total	71,089	398,855	43,550	488,277
	43,550			398.855
Decrease	27,539			
Increase				89,422

Philadelphia & Reading Railroad and Branches.

COAL TONNAGE

For the Week ending Saturday, March 16, 1872.

BY RAILROAD—ANTHRACITE.

PASSING OVER MAIN LINE AND LEB. VAL. BRANCH.

	Tons.	Cwt.
From St. Clair	47	256 11
" Port Carbon	7	836 09
" Pottsville		37 06
" Schuylkill Haven	17	312 12
" Pine Grove	3	351 19
" Tamaqua	8	262 12
" Harrisburg		
" Dauphin	1	222 13
Total	65	340 02

FOR SHIPMENT BY CANAL.

Passing Frackville Scales	698	14
" Mill Creek "	703	18
" Schuylkill Valley Scales		
" Mt. Carbon "		
" Cressona "	877	14
" Pine Grove "		
" Tamaqua "		
Total	2	280 06

SHIPPED WESTWARD VIA NORTHERN CENTRAL RAILROAD.

Passing Locust Gap	257	15
" Shamokin	4	430 03
" Herndon		
Total	4	687 18

SHIPPED WEST OR SOUTH FROM PINE GROVE.

Via Schuylkill & Susquehanna R. R.	1	296 19
" Lebanon & Pine Grove Branch		537 10
Total	1	834 09

CONSUMED ON LATERALS.

From Frackville Scales	888	14
" Mill Creek "	511	02
" Schuylkill Valley Scales	553	01
" Mt. Carbon "	574	03
" Cressona "	595	15
" Pine Grove "	180	14
" Tamaqua "	708	07
Total	4	011 18

LEHIGH AND WYOMING COAL.

Received via Allentown, E. Penn'a Br.	256	01
" " Alburtis, "		
" " Oreland, G. & N. Br.	1	273 15
" " Connecting R. R.		
" " Willow Street R. R.	242	17
Tota	1	772 13

BITUMINOUS.

From Harrisburg	10	230 11
" Connecting R. R., G. & N. Br.		
" Junction R. R.		80 01
Total	10	310 12

COAL FOR COMPANY'S USE.

Anthracite	4	777 13
Bituminous		257 17
Total	5	035 10

RECAPITULATION

	Total for Week.	Corresp'g week last year.	Increase and Decrease.
Passing over Main Line and Leb. Val. Branch	65,340 02	10,480 03	i 54 859 19
For Shipment by Canal	2.280 06	374 00	i 1,906 06
Shipped Westward via Northern Central R. R.	4,687 18	5,983 10	d 1,295 12
Shipped West or South from Pine Grove	1,834 09	967 03	i 867 06
Consumed on Laterals	4,011 18	1,476 05	i 2,535 13
Lehigh and Wyoming Coal	1,772 13		i 1,772 13
Total Anthracite paying freig't	79,927 06	14 284 07	i 66,645 19
Bituminous	10,310 12	10,432 17	d 122 05
Total of all kinds paying freig't	90,237 03	29,774 04	i 60,463 14
Coal for Company's use	5.035 10	3,991 09	i 1,044 01
Total Tonnage for Week	95,273 03	33,765 13	i 61,507 15
Previously this year	945,095 15	779,869 01	i 165,226 14
Total to date	1070 369 03	813.634 14	i 256,734 09

SHIPPED BY CANAL.

From Schuylkill Haven			
" Port Clinton			
Total Tonnage per Week			
Previously this year			
Total to date	13,355 16	36,225 17	d 22,870 10

Shamokin Coal Trade.

For week ending March 16, 1872	7,937 2
Same time last year	7,025 05
Increase	914 07
Decrease	
Total amount shipped to date	76,117 11
Same time last year	88,522 02
Increase	
Decrease	12,404 11

Report of Coal Transported over Lehigh Valley Railroad.

Report of coal tonnage for the week ending March 16, 1872, with totals to date, compared with same time last year.

WHERE SHIPPED FROM.	WEEK. Tons.	WEEK. Cwt.	TOTAL Tons.	TOTAL Cwt.
Total Wyoming	9 141	15	142,402	17
" Hazleton	41,161	14	606,991	02
" Upper Lehigh	66	15	850	07
" Beaver Meadow	14,731	07	186,771	01
" Mahanoy	5,169	02	58.042	06
" Mauch Chunk	185	12	1,052	19
Total	70,458	05	806,110	12
Same time last year	7,998	05	426,976	16
Increase	62,860	00	469,133	16
Decrease				
Forwarded East from Mauch Chunk by rail	60,183	16	776,078	02
Same time last year	6,887	00	373,716	09
Increase	53,296	16	402 361	13
Decrease				

DISTRIBUTED AS FOLLOWS.

Forwarded East from Mauch Chunk by rail	59,115	13	760,375	04
do East for use L. V. R. R.	1,068	03	15,702	18
Delivered at and above Mauch Chunk for use of L. V. R. R.	1,435	00	17,771	11
To P. & N. Y. R. R.	6,689	10	78,383	09
To N. C. R. R., at Mount Carmel			73	06
To D. H. & W. R. R.	854	18	5,628	14
To L. & S. R. R. at Packerton for rail	567	02	4,681	08
Delivered at M'h Chunk	49	02	694	17
Delivered on line of road above Mauch Chunk	452	06	7,283	01
To L. & S. R. R., at Penn Hav., for railroad	124	04	3,891	02
Do. for canal			864	07
To Lehigh Canal Mauch Chunk			99	07
To Catawisa Railroad	182	07	661	07
Total	70,458	05	896,110	12

Report of Coal Transported over Central R.R. of N. J. (Lehigh and Susq. Div.)

Week ending March 16—Compared with same time last year.

WHERE SHIPPED FROM	WEEK 1872., tons ct	WEEK 1871., tons ct.	YEAR 1872 tons cwt.	YEAR 1871, tons.cwt.
Wyoming Region	22700 14	1686 18	219635 01	54523 03
Upper Lehigh Region	4449 06		38394 13	4614 03
Beaver Meadow Region				
Hazleton Region	474 02	10 07	3399 08	813 04
Mahanoy Region				
Treskow Region	1472 07		75.5 10	1013 03
Mauch Chunk Region	11590 14	139 01	65764 03	17617 18
Totals	40687 02	1836 06	334718 15	78652 00
Increase	38850 17		256066 15	
Decrease				
DISTRIBUTION.				
Forwarded East of Mch Chunk by Rail	35207 06	1559 04	275789 18	67128 02
Forwarded East of Mch Chunk by Canal				
Delivered at and above Mauch Chunk	1757 11	220 18	13709 09	9437 12
L. V. R. R at Packer'n	440 00	56 04	3537 19	2093 06
Delivered to L. & B. R. R. at Plymouth Bridge	3282 06		41681 09	
Totals				
Of the above there was transported on acc'nt of L. C. & N. Co.	12965 19	139 01	71628 09	49817 04
W.-B. C. & I. Co.	17713 16	1217 18	160738 03	38873 07
Totals	30679 15	1416 19	232366 12	88690 11
Increase	29252 16		143676 01	
Decrease				

Penn. and N. Y. R. R.—Coxton, Pa.

Coal tonnage for week ending March 16, 1872.

	Week. Tons.	Week. Cwt.	Total. Tons.	Total. Cwt.
Anthracite received:				
From Lehigh Valley R. R.	6609	10	78,383	09
" Lack. & B. R. R.	869	12	20,055	17
" Pleasant Valley R. R.	1291	09	27,840	09
" Snl. & Erie R. R.	1109	05	15,170	12
Total	9,879	16	141,450	07
Distributed:				
To Lehigh Valley R. R			18,115	15
To Lack. & B. R. R.	162	12	885	14
To S. Central R. R	3508	13	22,589	08
To Ithaca & A. R. R.	1450	18	32,052	18
To Erie R. W. Pockets for shipm't.	3004	13	37,161	09
To individuals on line of road	487	03	9,689	16
To points at & above Carbon for use of Co.	238	16	7,198	16
To points between Waverley and Elmira	977	01	13,756	11
Total	9,879	16	141,450	07
Bituminous:				
Received from Barclay R. R.				
Shipped North from Towanda	6208	02	80 877	10
Shipped South from Towanda	25	06	741	05
Northern Central R. R.			91	01
Total	6233	07	81,709	16
Distributed:				
To Erie R. R.	6006	18	70,348	05
To So. Central R. R.	201	04	10,577	10
To Ithaca & A. R. R.			21	15
To Lehigh Valley R. R.	25	06	652	14
To individuals on line of R R.			253	11
Total	6233	08	81,709	16

Huntington and Broad Top R. R. Co.

For week ending March 16, 1872	6,803 tons.
Same time last year	8,182 "
Increase	1,380 "
Decrease	
Total amount shipped to date	59,711 "
Same time last year	57,205 "
Increase	2,506 "
Decrease	

Lehigh Coal and Navigation Company.

Report of Coal transported over the Lehigh Canal and L. & S. Div. of Central Railroad of New Jersey for the week ending March 16, 1872, and for the year 1872.

	WEEK.	YEAR.
Forwarded East of Mauch Chunk by Rail	35,207	275,789
Delivered at and above do.,	1,757	13,709
Forwarded East of do., by Canal..	....	....
	36,964	289,499
Corresponding period last year—		
Forwarded East of Mauch Chunk by Rail.....	1,559	67,128
Delivered at and above do.,	220	9,430
Forwarded East of do., by Canal..	....	....
	1,780	76,558
Increase on Railroad	35,184	212,940
Decrease " "		
Increase on Canal		
Decrease " "		
Of the above there was transported on account of—		
Lehigh Coal Nav. Co	12,965	71,628
Wilkesbarre Coal & Iron Co	17,713	160,738
	30,679	232,366
Corresponding period last year—		
Lehigh Coal Nav. Co	139	18,854
Wilkesbarre Coal & Iron Co	1,277	38,873
	1,416	57,727
Increase	29,252	174,639
Decrease		

Delaware and Hudson Canal Company.

The following is a statement of Coal Transpo ted by the Delaware and Hudson Canal Co. for the week ending March 16, 1872.

	FOR THE WEEK.	FOR THE SEASON.
By Delaware and Hudson Canal,	.....	
By Railroad, East	16,082	119,681
" " West	5,876	79,923
" " South	5,698	69,751
Total Tons	27,656	269,355
For the same period last year.		
	FOR THE WEEK	FOR THE SEASON.
By Delaware and Hudson Canal,		
By Railroad, East		48,332
" " West		12,721
" " South		.....
Total Tons		61,053
Increase		208,302

Delaware Lackawanna & Western Rail Road Company.

Coal transported on the Delaware, Lackawanna and Western R. R., for week ending March 16, 1872:

	Week. Tons. Cwt.	Year. Tons. Cwt.
Shipped North	11,443 17	136,030 09
Shipped South	38,722 02	406,040 10
Total	50,165 19	542,070 19
For the corresponding time last year:		
Shipped North		
Shipped South		
Total	2,719 18	3 657 12
Increase	47,446 01	538,413 07
Decrease	.....	.....

Delaware and Hudson Canal Company.

Coal mined and forwarded by the Delaware and Hudson Canal Company for the week ending Saturday, March 16, 1872.

	WEEK.	SEASON.
North	47,082 06	502,559 12
South	5,698 09	69,750 14
Total 1872	52,780 15	572,310 06
Corresponding time in 1871:		
North	Suspension.	
South	"	
Total		
Increase North		
Decrease North		
Increase South		
Decrease South		
Total decrease 1872		
Total increase 1872	52,780 15	572,310 06

Statement of Coal Transported over Cumberland and Pennsylvania Railroad

During the week ending Saturday March 16, and during the year 1872, compared with the corresponding period of 1871.

WEEK.

	To C. & O. Canal. Tons. Cwt.	To E.&O.R.R. Co Tons Cwt.	Total. Tons. Cwt.
1872	193 06	19,279 14	19,473 00
1871	14,318 06	26,453 17	40,772 03
Increase			
Decrease	14,125 00	7,174 03	21,299 03

YEAR.

1872	413 16	200,075 10	200,489 06
1871	19,7.8 08	158,837 05	178,565 13
Increase	.....	41,238 05	21,923 13
Decrease	19,314 12		

Prices of Gas Coals.

March, 1872.

PROVINCIAL.

Corrected weekly by Louis J. Belloni, Jr., 41-43 Pine st., N. Y

Duty, $1 25, gold

	Coarse	Slack.
Block House	$1 60 @-1 75	
Gowrie	1 60 @-1 75	

Corrected by Bird, Perkins & Job, 86 South street.

	Coarse.	Culm of Coal.
Pictou	$2 25 @1 25	
Sydney	2 25 @- 80	
Lingan	1 60 @- 80	
Little Glace Bay	1 60 @1 00	
Caledonia	1 60 @- 80	

A discount from the prices of the coarse Coal on purchase of 5000 tons and upwards. Duty $1 25 per ton, gold, on the coarse coal. 25 per cent. ad valorem on the Culm of Coal

AMERICAN.

	Currency.
Westmoreland	$7 00 @- —
Fairmount Gas Coal Co. of N. Y.	7 00 @- —
Despard Coal Co	7 00 @- —
Penn	7 00 @- —
Newburg Orrel Gas	— — @- —
West Fairmount Gas Coal	7 00 @- —
AT PHILADELPHIA.	
Powelton	$6 75
TO NEW YORK.	
Provincial	
Sidney	$3 25
Lingan	3 25
Cow Bay	37½
Port Caledonia	3 37½
Little Glace Bay	3 25

Prices of Coal by the Cargo.

[CORRECTED WEEKLY]

	AT NEW YORK, March 15. R. A.	W. A.	AT PHILADELPHIA. March 15. R. A.	W. A.
SCHUYLKILL.				
Lump	$- —	$- —	- —	
Steamer	- —	- —	- —	- —
Broken	- —	- —	- —	
Egg	- —	- —	- —	- —
Stove	- —	- —	- —	- —
Chestnut	- —	- —	- —	
Pea	- —	- —	- —	- —
LEHIGH.				
Lump, (along side)	5 00	—	- —	- —
Broken	4 75	- —	- —	- —
Egg	4 50	- —	- —	- —
Stove	5 25	- —	- —	- —
Chestnut	4 25	- —	- —	- —
Pea	- —	- —	- —	- —
SPECIAL COALS.*				
Honey Brook, Le'h W. A.	4 00@4 75		- —	- —
Spring Mountain " "	- —@- —		- —	- —
Sugar Creek " "	- —@- —		- —	- —
Sugar Loaf " "	- —@- —		- —	- —
Old Comps's " "	4 00@4 75		- —	- —
Room Run " "	4 00@4 75		- —	- —
McNeal " "	- —		- —	- —
Girardville " "	- —		- —	- —
Hill & Harris " "	- —		3 10@4 00	-
Shamokin " "	- —		- —	- —
Lykens Valley " "	- —		- —	- —
Broad Top " "	- —		- —	- —
McMichael " "	- —		3 25@4 25	- —
Henry Clay " "	- —		- —	- —
Powelton " "	- —		- —	- —

Dealers in these coals may be found in our advertising columns.

Company Coals.

March, 1872.

	L.	Str.	Gra.	Eg.	Sto	Chest
*Scranton at E. Port	3 39	3 77	3 63	4 02	4 10	3 34
*Pittston at Weehawken	4 00	4 00	4 15	4 25	4 50	4 60
*Lackawana at Weehawken	3 75	3 75	3 85	3 85	4 25	3 75
Wilk'b're at Hoboken	3 75	3 75	3 85	3 85	4 25	3 75
Old Co. Lehigh at Pt John's	4 75	—	4 00	4 00	4 50	4 00
Lehigh at Eliz. Port	4 75	—	4 00	4 00	4 50	4 00

For freights to different points see "Freights."

* To contractors only.

Freights.—March, 1872.

TO EASTERN PORTS.	Cumberland. From Georgetown.	Cumberland. From Baltimore.	Anthracite. From Philada.	Anthracite. From Eliz. Port, Port Johnson and Hoboken.	Anthracite. From Newburg.	Anthracite. From Rondout.
Amesbury						
Bangor						
Bath						
Boston		3 25		2 75		
Bridgeport		2 75		1 00		
Bristol						
Derby						
Dighton		2 75				
East Cambridge						
Fall River		2 75				
Hackensack						
Hartford						
Hartford						
Jersey City		2 00		50		
Middletown						
Mystic						
New Bedford		3 00				
Newburyport		3 50				
New Haven		2 75		1 00		
New London		2 75	3 50	1 40		
Newport				1 75		
New York	2 25	2 30		50		
Norwalk				1 00		
Norwich				1 50		
Pawtucket						
Portland		3 25		2 00		
Portsmouth, N. H		3 50				
Providence		2 75		1 75		
Rockport						
Saco						
Sag Harbor						
Salem		3 40		2 75		
Stamford						
Stonington				1 50		
Taunton						
Warren						
Washington						
TO RIVER PORTS.						
Albany						
Catskill						
Cocksackie						
Coeyman's						
Cold Spring						
Fishkill						
Haverstraw						
Hudson						
New York						
Nyack						
Poughkeepsie						
Rhinebeck						
Rondout				70		
Saugerties						
Sing Sing						
Stuyvesant						
Tarrytown						
Troy						
West Point						
Yonkers						

Prices of Foreign Coals.

March, 1872.

Duty $1 25 per ton.

Corrected weekly by PARMELE BROS., No 32 Pine street, N. Y.

Liverpool Gas Caking	$ 8 00@— —
" " Cannel	12 00@13 00
" House "	18 00@20 00
" Orrel	14 00@16 00

Per ton 2,240 lbs., ex-ship.

PRICES FROM YARD.

Liverpool House Orrel, screened	$16 00@17 50
" Cannel, "	20 00@25 00

Per ton 2,000 lbs. delivered.

Rates of Transportation to Tide Water.

BY RAILROAD.

TO PORT RICHMOND, PHILADELPHIA.

Philadelphia and Reading Railroad, from Schuylkill Haven for consumption	$1 25
For reshipment	

MAUCH CHUNK TO ELIZABETHPORT.

L. V. Railroad from Mauch Chunk to Phillipsburgh	$0 64
C. R. R., N. J., Phillipsburgh to Elizabethport	0 95
Shipping expenses at Elizabethport	25
Wharfage	10
Total	$1 94

MAUCH CHUNK TO PORT JOHNSON.

L. V. R. R., or L. & S. R. R. from M. C. to Phillipsb'g	$0 64
C. R. R., of N. J., Phillipsburgh to Pt. Johnson	0 95
Shipping expenses	25
Wharfage	10
Total	$1 94

TO HOBOKEN.

L. V. R. R., Mauch Chunk to Phillipsburgh	64
Morris & Essex R. R. Phillipsburgh to Hoboken	0 95
Shipping expenses	25
Wharfage	10
Total	$1 94

TO SOUTH AMBOY.

L. V. R. R.	72
B. & D. R. R.	91
Cam. & Am R. R.	
Shipping Expenses	35
Total	$1 08

PENN HAVEN TO ELIZABETHPORT.

L. V. R R. Penn Haven to Phillipsburgh	0 75
C. RR. of N. J. Phillipsburgh to Elizabethport	0 95
Shipping expenses	25
Wharfage	10
Total	$ 2 05

MARKET REVIEW.

FOR THE WEEK ENDING MARCH 23, 1872.

IRON—There continues quite an active inquiry for Scotch Pig, and the stock being very much reduced, prices have further appreciated, closing at $49 for Englinton, and $50 for Glengarnock, with very little to be had at these prices; the sales are 150 tons Eglinton, to arrive, at $49; and 100 do. Glengarnock, on private terms. American is in light supply and good demand at the advance noted in our last; sales have been made of 200 tons No. 1 Poughkeepsie at $48 a $49; 100 do. No. 2 do., $47; and 500 do. No. 1 Lehigh, $50. Wrought Scrap continues in request, and we notice sales of 350 tons from yard at $60 a $60.50 per ton. There has been considerable inquiry for new Rails, and English are a trifle higher, but we hear of no sales of moment; we quote English $68 a $70 gold, and American $76 a $80 currency, according to location of mill; 1000 tons old Double-headed sold, to arrive, on private terms. Refined Bar, from store, continues very firm at our quotations, as also at the Mills. Rowland (Philadelphia) asks 4 5-10 cents—100 tons English Refined, assorted Bar sold to arrive, at $95 currency. Russia Sheet is quiet but firm—250 packs sound and strained sold on private terms. Common Black Sheets are firm at our quotations. Orders taken in England for Iron to come here, 6 mos. ago, are not yet filled.

PHILADELPHIA, March 16.—Review of the Philadelphia market by Edward Samuel: No large sales of Pig reported. Importers are asking $44 for future shipment of Eglinton to this port. Old Rails are held firmly. New Rails are firm, many mills refusing to book orders at less than $81 a $82. No change in merchant Bars. Below are the closing prices: American No. 1 Foundry Pig at furnace $43 a $44, No. 2 $41 a $42, No. 3 Forge Pig $40 a $41, and No. 4 White and Mottled $37 at $39; No. 1 Wrought Scrap, ex-ship, currency, $50 a $51; American Refined Bar, mill price, $98.56, and do. Rails at mill $78 a $80.

LEAD—Foreign Pig remains very quiet and we hear of no sales; prices are without change. Bar is steady at 9¼ cents, Sheet and Pipe 10, and Tin-lined Pipe 15, less 10 per cent to the Trade.

COPPER—As yet there has been no change in manufactured, though with the continued rise in Ingot, an advance seems imminent. We quote New Sheathing 36 cents, Bolts and Braziers 38, Bronze and Yellow Metal Sheathing 26, and Y. M. Bolts 28. The stock of Ingot is small, and under easy control, so that purchasers have to pay holders demands, or go without supplies. Prices are again ½ a 1 cent per lb. higher. The transactions embrace about 400,000 lb. Lake, commencing at 29¾ cents, and closing at 30½ for immediate and early April delivery. Cash lots are now held at 30½ a 31 cents.

SPELTER—Owing to the long passages of sailing vessels from Europe, the stock on the spot, especially of fine brands Silesian, has become much reduced, and for the little here holders ask 7⅞ cents gold; to arrive, however, good brands are offered in considerable parcels at 7½, and common at 7 gold. We have only to notice the sale o 25 tons Silesian, to arrive, at 7¼ cents gold.

STEEL continues firm and steady for lots as wanted from store.

TIN—Pig continues agitated and unsettled, prices

steadily favoring sellers, Straits and English having further advanced since our last ½ a ¾ cents per lb. gold, and Banca 1½ a 2 cents; the latter is now quoted in Holland florins 92½, and Billiton in Singapore $38 50, a rise since last week of 75 cents per picul. Sales have been made of 400 slabs Billiton at 39¾ cents; 1000 do. Straits, 39; 1600 do., 39¼ a 39¾; 200 do., 40, 200 do. Banca, 43½ a 44½; and 5 tons English, 39½, all gold. The closing quotations were Straits 40 cents, English 39½, and Banca 46; very little of the latter here. In our list, in noting the quantity to be offered at the approaching Dutch sale, the types made us say 23 a 24,000 slabs Billiton, in addition to 53,000 slabs Banca; the quantity of Billiton should have read 23 a 2400—this, added to the 53,000 slabs Banca, makes a very much smaller quantity than before declared at the semi-annual sales in many years. This has been an important element in the recent rapid rise in prices in Europe, and reflected here. Plates continue in demand, notwithstanding the recent successive advances in prices, and the business is large and the market buoyant. The stock of I. C. Charcoal is reduced very low; the sales are 3200 bxs. ¼d X Charcoal Tin and Extra, $11.75 a $12; 400 do. Assorted do., $11.75; 100 do. I. C., 14 by 20, $12.50; 6150 do Charcoal Terne, $10.25 a $10.50; 100 bxs. do., 20 by 28, $20.50; 1000 do. I. C. Coke $10.50, all gold: and 1500 do., to arrive, on private terms.

ZINC is firm at 7 a 7½, for Am. ox 8¼ a 8¾, for French and sheet 10 a 11, Manganese 4 a 4½.

From a recent number of the *Portage Lake Mining Gazette* we have condensed the following figures in reference to the copper and iron production of the Lake Superior District, from 1845 to 1872. The production of copper for 1871 was divided as follows:

	Tons.	Lbs.
Houghton county	12,791	1,295
Ontonagon county	938	1,407
Keweenaw county	2,340	1,391
Total	16,071	393
Total in 1870	16,183	39
Decrease in 1871	111	1,646

The total copper product from 1845 to 1871, inclusive, was 160,529 tons. The amount of ingot copper produced from 1854 to 1871, inclusive, was 124,243 tons, valued at $68,528,600

The proceeds from assessments during the same period was 17,106,500

Making the total proceeds $85,635,100
Returned by dividends 8,680,000

Balance $76,905,300

Percentage of dividends to total proceeds 10.13 per cent.
" " copper sales 12.66 " "
" " assessments 50.74 " "

The pig iron produced from the same district for 1871 was 51,225 tons
The product of 1870 amounted to 47,848 "
Increase 3,377 "

The total amount of iron ore produced from 1856 to 1871 was 4,582,074 tons.

The amount of pig iron produced from 1858 to 1871, inclusive 290,385 "

The combined value of iron produced for the period above mentioned is estimated at nearly $34,000,000.

The tables from which the above figures are extracted, "with but one or two exceptions," exhibits an uninterrupted increase of supply, both of iron and copper from year to year, beginning, for example, with pig iron, which, in its first year of production, only furnished us with 1,629 tons. This amount has gradually increased, and to-day the yearly supply exceeds the product of 1858 by nearly 50,000 tons, an exhibit which we look upon with great satisfaction.

METALS.

NEW YORK, March 20, 1872.

IRON.—Duty: Bars, 1 to 1½ cents ₰ lb; Railroad, 70 cents ₰ 100 lbs.; Boiler and Plate, 1½ cents ₰ lb; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾ cents ₰ lb; Pig, $7 ₰ ton; Polished Sheet, 3 cts. ₰ lb; Galvanized 2½; Scrap Cast, $6; Scrap Wrought, $8 per ton

	Store Prices.
Pig, Scotch No. 1, ₰ ton	46 00@50 00
Pig, American, No. 1	50 00@— —
Pig, American, No. 2	49 00@— —
Pig, American, Forge	48 00@— —
Bar Refined, English and American	95 00@100 00
Bar Swedes, assorted sizes (gold)	95 00@100 00
	Store Prices, Cash.
Bar, Swedes	117 50@127 50
Bar, Refined, ¾ to 2 in. rd. & sq. 1 to 6 in. x ¾ to 1 in.	100 00@— —
Bar, R-fined, 1¾ to 6 by ½ & 5:16 & 2½ to 2⅞ rnd. sq..	105 00@— —
Bar, Refined, 1 & 1¼ by ¼ & 5:16	107 50@— —
Large Rounds	110 00@137 50
Scroll	117 50@147 50
Ovals and half-round	115 00@135 00
Band	— —@112 50
Horse Shoe	112 50@122 50
Rods, ⅜ to 3-16 inch	105 00@150 00
Hoop	120 00@167 50
Nailrod	7½@— —
Sheet, Russia, as to assortment (gold)	16½@ 17 —
Sheet, Singles, D. and T. Common	—6 @— 7
Sheet, D. an i T. Charcoal	—7 @— 8
Sheet, Galv'd, Nos. 10 to 27	10@13c lb.
" " Nos. 28, and 29.	15@19c lb.
Rails, English (gold), ₰ ton	65@70 00
Rails, American, at Works in Pa	76@80 00

COPPER.—Duty: Pig, Bar, and Ingot, 5; old Copper 4 cents ₰ lb; Manufactured, 45 per cent. ad val.

	All Cash.
Copper, New Sheathing, ₰ lb	— @— 36
Copper Bolts	— @— 38
Copper Braziers, 16oz. and over	— @— 38
Copper Nails	— @— 42
Copper, Old Sheathing, &c. mixed lots	25½@— 26
Copper, Old, for chemical purposes, 14@16 oz	— @— —
Copper, American Ingot	30½@— 31
Yellow Metal, New Sheathing & Bronze	— @— 26
Yellow Metal Bolts	28 @— —
Yellow Metal Nails	— @— 28

LEAD.—Duty: Pig, $2 ₰ 100 lbs.; old Lead, 1½ cents ₰ lb: Pipe and Sheet, 2¾ cents ₰ lb.

Galena, ₰ 100 lbs	$—	@— —
Spanish (gold)	5 90	@6 00
German, do.	5 90	@6 00
English do.	5 95	@6 70
Bar (net)	9 25	@ —
Pipe (net)	— —	@10 00
Sheet	— —	@10 00

Colwell, Shaw & Willard Tin-Lined Lead Pipe 15 cts. ₰ lb.

STEEL.—Duty: Bars and ingots, valued at 7 cents ₰ lb or under, 2¼ cents; over 7 cents and not above 11, 3 cents ₰ lb; over 11 cents, 3½ cents ₰ lb, and 10 ₰ cent ad val. Store prices.

English Cast (2d and 1st quality) ₰ lb	— 16 @— 18
English Spring (2d and 1st quality)	— 7 @— 10
English Blister (2d and 1st quality)	— 10 @— 17
English Machinery	— 11 @— 13
English German (2d and 1st quality)	— 10½@— 12
American Blister "Black Diamond"	— — @— 12
American, Cast, Tool do.	— 15 @— 16
American, Spring, do.	— 9 @— 11
American Machinery do.	— 9 @— 10
American German, do.	— 9 @— 11

TIN.—Duty: Pig, Bars, and Blocks, 15 ₰ cent. ad val.: Plate and Sheets and Terne Plates, 25 ₰ cent.; Roofing 25. ad val.

	Gold ₰ lb.
Banca	— @46
Straits	40 @—
English	39½@—

PLATES.	Gold.	Currency.
Fair to Good Brands.		
I. C. Charcoal, ₰ box	$12 00 @12 25	$13 50 @13 75
I. C. Coke	10 50 @10 75	11 75 @12 25
Coke Terne	9 25 @ 9 75	10 50 @11 00
Charcoal Terne	10 25 @10 50	10 50 @12 00

SPELTER—Duty: In Pigs, Bars & Plates, $1.50 p. 100 lb

Plates, Foreign	(gold) p. 100 lb.	7 12½@ 7 37½
Plates, Domestic	p. lb.	— 7 @— 11

ZINC—Duty: Pig or Block, $1.50 per 100 lb.; Sheet 2½c per lb

Sheet	per lb.	— 10 @—11

San Francisco Stock Market.

BY TELEGRAPH.

Our report from the San Francisco Stock Market is dated the 19th inst. The market as again advanced; as will be seen on a comparison of the two following reports; the advance has been general and uninterrupted. Amador is appended to ahe report as selling at $300—a recent San Francisco contemporary, states that the future production of the Comstock Lode is an evident fact, and that a season of prosperity is being inaugerated far beyond any previous period in the history of mining interests on the Pacific Coast. It also deplores the combinations which insiders form for the purpose of placing fictitious values on these stocks which they sell to outsiders, who, as a rule, pocket the loss and venture again to retrieve, but almost invariably with the same result as at first. We called attention to this fact several weeks ago, but we suppose that it is one of those uncertain certainties which its purchasers will only obtain by experience.

	March 19.	March 14.
Savage	250	225
Yellow Jacket	85	85
Kentuck	280	262
Chollar Potosi	70	60½
Gould & Curry	228	200
Belcher	610	—
Amador	300	—
Imperial	140	112
Eureka C. V.		16½

The characteristic feature of the Mining Stock Board is dullness that is a term which would fitly represent the condition of the market for several weeks past; the transfers of Gold Stocks during the past week have been confined to a sale of 500 Central on the 15th inst. at 5 cents per share, and two transfers of Lacrosse, 500 shares each, at 18 and 20 cents cents per share respectively- the quotations are as annexed.

	BID.	ASKED.
American Flag	—	20
Bates & Baxter	25	—
Benton	—	5
Black Hawk	30	50
Central Gold	—	5
Casco Gold	—	—
Cona Gregory	17	30
Grass Valley	—	10
Gunnell	—	—
Holman	—	—
La Crosse	19	21
Liberty	—	—
Mariposa prf	—	—
Rocky Mount	—	5
Quartz Hill	8	15
Smith & Farm	12	—

Petroleum in sympathy with gold stocks is dull, even more so than its cotemporary; not even the great excitement which is agitating all Petroildum seems to exercise the least influence *pro* or *con*, over the old beaten track comprised in the following list of quotations furnished by the Board.

	BID.	ASKED.
Bennehoff Run	21	—
Breevoort	1 75	2 50
Buchanan Farm	35	—
Central	45	—
New York & Allegheny	1 25	—
Northern Light	30	—
Phillips Pet	—	15
Pithole Creek	—	1 00
Rathbone Oil	20	—
Rynd Farm	25	30
Second National	—	—
United Petroleum Farms	28	35
United States	—	60

MISCELLANEOUS.

100th Auction Sale.

125,000

TONS SCRANTON COAL

On WEDNESDAY, MARCH 27th, 1872.

NEW YORK, March 20th, 1872.

The Delaware, Lackawanna and Western Railroad Company will sell, by MESSRS. JOHN H. DRAPER & CO., Auctioneers, at the Company's Sales Room, 26 EXCHANGE PLACE, corner of William Street, NEW YORK, on WEDNESDAY, MARCH 27, at 12 o'clock, noon,

125,000 TONS

OF

COAL, FROM THE LACKAWANNA REGIONS,

of the usual sizes, deliverable at their Depot, Elizabethport N. J., during the month of April, 1872.

The sale will be positive; each lot put up will be sold to the highest bidder; no bids, in any form whatever, being made for account of, or on behalf of the Company. The conditions will be fully made known at the time of sale.

TERMS: FIFTY CENTS PER TON, payable in current funds, on the day of sale, and the balance, within ten days thereafter, if required, at the office of the Company,

SAMUEL SLOAN, *President.*

STEEL MEASURING TAPES, Manufactured by W. H. PAINE, 116 Freeman street Greenpoint, opposite New York City. Send for Circular.

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PUMPING MACHINERY

Large and Splendid Illustrated Catalogue Sent Free, on Application.

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A MINING ENGINEER AND SURVEYOR IS open to an engagement. Thoroughly practised in **Coal and General Mining Operations, Railroad Work and Tunneling.**

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BLOWPIPING.

THE UNDERSIGNED IS FORMING A CLASS for instruction in BLOWPIPING, especially for the examination of Ores and Minerals. Course of Ten Lessons. Address,

H. B. CORNWALL, E. M.,
School of Mines, corner 49th Street and 4th Avenue.

BLACK LEAD MINE.

TO LET for a term of years. A *Black Lead Mine* of superior quality—with machinery and everything complete to work the same—within 25 miles of New York, and railroad and canal communication close to the premises. Apply to or address

H. J. DAVID,
2t. 33 Park Row.

THOMAS M. DROWN,

CHEMIST AND METALLURGIST,
209 South Sixth Street,
PHILADELPHIA.

Analyses of Ores, Coals, Smelting Products, etc. Examinations of Metallurgical Processes. Instruction in Analytics Chemistry. d5:6mo

KENRICK & COMPANY

MINING & RAILWAY CONTRACTORS, SINKERS, &c.
WILKES BARRE,
eb.20 t.f Penn.

Polytechnic Association of the American Institute.

Meeting held March 8, 1872, President TILLMAN in the chair.

DANISH STEAM NAVIGATION.

Prof. WHITNEY read a paper describing a visit to the Danish iron steamship now visiting the port of New York, which will be found elsewhere.

The PRESIDENT read a paper on Atoms and Molecules.

Dr. J. V. C. SMITH remarked upon the similarity between the modern theories and those taught three thousand years ago.

Prof. WHITNEY pointed out the progress which has been made, notwithstanding apparent resemblance of theories, and said that although nations had risen and fallen, nothing that man needs for his advance had ever been lost.

Mr. ROOT expressed the opinion that matter in its primary condition is probably homogeneous, without grain or fibre, instead of being constituted of atoms or molecules. Supposing the atoms to be at equal distances, and the attraction perfectly balanced, the moment the equilibrium is disturbed, throwing two particles nearer together, their attraction increasing inversely with the square of the distance, they would come together. The whole mass would thus be broken up into groups of atoms.

The PRESIDENT suggested that there is a fluid between the atoms, and that when they are made to approach, this fluid is compressed, its elasticity counterbalancing the increased attraction.

Mr. ROOT also expressed the opinion that cohesion and chemical force are the same force with gravitation, the closeness of the parts increasing the attraction.

The PRESIDENT said that in hydrochloric acid, the hydrogen may be replaced by soda, forming common salt, proving that a heavy body may replace a light one, or *vice versa*; and therefore that chemical affinity is not the same with the attraction of gravitation. Again, bodies united by chemical affinity can be separated by electricity.

Mr. ROOT said that he would prefer to say that there is a law of attraction, and a law of repulsion; the two accounting for all the varieties of attraction.

SELF-LOCKING SCREW.

Mr. FREELAND exhibited a screw, intended especially for railroad purposes, and similar positions, where the perpetual jar has a tendency to loosen the nut. The screw has a longitudinal recess, in which is placed a brass wire bent at the end by a small apparatus; and the nut has a cavity with a ratchet upon its exterior, the end of the brass wire taken in the teeth as a pawl. On tightening the screw, the brass wire holds the nut in position. The screw may at any time be tightened, and the wire will hold it in its new position. If the nut is to be loosened, sufficient force must be applied to the wrench to break the wire; and a new wire inserted on again putting on the nut.

Mr. ROOT. The only objection would be the cost of making it, and that when the nut binds close to the bolt, there is less tendency to lateral motion. There might possibly be some difficulty from water getting into the slot and rusting the thread.

ROAD STEAMER IN GREECE.

Mr. J. K. FISHER read the following paper:

The *Engineer* of Feb. 16, has a letter from Patras, from Mr. BLAKEVAY, engineer to the Hellenic Road Steamer Co., from which I extract the following: "On the 26th of January we tried our first road steamer, with omnibus attached, carrying seventy to eighty passengers. The steepest grade was 1 in. 17, up which the engine took its way steadily at three miles per hour. The road had been recently covered with loose soil; but that did not cause the rubber tires to slip. On the levels the average speed was eigh miles per hour. The trial was on the whole satisfactory; and when it is considered that the engine and omnibus do the work of twenty ordinary carriages, forty horses, and twenty men, at a fifth of the cost, the system may be expected to prove advantageous.

Mr. ROBERT WEIR then read a notice of a lecture by Prof. A. M. MAYER delivered before the Sheffield Scientific School at New Haven, Conn.; an extract of the lecture giving an account of an original experiment to show the lengthening and shortening of sound waves by the movement of the vibrating fork, will be found elsewhere.

The Hell Gate Obstructions.

WE have from time to time spoken of the operations for the removal of the obstructions at Hell Gate, which are now progressing under the charge of General NEWTON; and the Superintendent of the work, Mr. REITHEIMER. The work is still progressing satisfactorily, one of the headings being already under the deepest part of the present channel. The drilling of the holes for blasting in the tunnels is done by machine drills, the diamond and the Burleigh drill being used side by side in different headings. The drilling in the cross-courses is done by hand.

It is interesting to know that the authorities have lately settled upon a depth of 32 feet below low-water mark for the future channel, and that in order to reach this result with certainty, the present galleries and cross-courses are driven upon a level from two and a half to three and a half feet below the required depth. This will prevent ridges, which might otherwise remain above the level settled upon after the explosion of the grand blast.

The thickness of the roof left standing is from 7 to 10 feet, the width of the tunnel and the cross-galleries is 16, and their height from 22 to 25 feet. The pillars now remaining to support the roof are intended to serve as the receptacles for the charges of nitro-glycerine for the final blast. For this purpose narrow tunnels will be driven into them, from which short side-tunnels will be run. The size of these will of course vary with the size of the pillar.

There are at present four Burleigh and two diamond-pointed drills in use, but the latter have given such entire satisfaction that three more are to be added. With this machine holes are generally bored about 15 feet deep, and then filled tightly with clay or sand up to the distance judged most advantageous for the first blast. The depth of the hole thus left open for the introduction of the charge, varies of course continually according to the character and exposed surface of the rock to be removed. After the blast, the sand or clay is removed from another part of the hole, which is then charged, and so on.

The blasting has thus far been principally done by means of nitro-glycerine, which is introduced in the holes enclosed in cartridges, covered with a water-proof composition of Mr. REITHEIMER'S invention. The explosion is effected by the electrical spark, and the simultaneous firing of several holes is carefully avoided, in order to prevent too great a shock to the roof, which might cause seams to open and admit the water from above. If such seams are opened, or struck in the soft strata of the gneiss, they are either closed with wooden plugs, or, if of great extent, they must be rendered harmless, as has been done in tunnel No. 3, by closing them by means of strong wooden shields, oakum and cement. In order to test the strata ahead, the borings are always kept at least five feet ahead of the tunnel-heading.

Mr. REITHEIMER informs us that he expects to complete the work, as far as the mining portion is concerned, in about eighteen months. For the final blast seven thousand pounds of nitro-glycerine are to be introduced, and as the effect of this quantity is equal to 70,000 lbs. of common blasting powder, it is confidently expected that the whole of the Hallet's Point reef will instaneously be blown up, leaving the rocks of sufficiently small size to permit their removal by grappling machinery.

Mr. REITHEIMER expects soon to receive orders to start operations on Pot Rock and the Gridiron. The general plan for this work is to sink two shafts, to be connected by a main gallery, from which side galleries will run right and left towards deep water.

Danish Iron Steamers.*

The two steamers, Rolf and Thorvaldsen, are the first iron vessels built in Denmark that have visited this country. I passed about two hours on the Thorvaldsen, and found her a staunch, well-built steamer, registering 884 tons. The dimensions are 228 feet long, 30 feet beam, and 17 feet draft, when laden. The motive power comprises two inverted vertical compound engines, each of 60-horse power, nominal, and connecting direct to the propeller shaft; the propeller has a diameter of thirteen feet. The boilers, which are two in number, and worked at an average pressure of fifty-five pounds per square inch, are of the tubular return type, and are claimed to give a notable economy of fuel, from two and one-half to three pounds per indicated horse-power per hour. Some features of the boilers are worthy of general imitation, all the rivet holes being drilled instead of punched, and the fire-boxes, or furnaces, being turned to fit their places in the boiler shells, to which, by riveting, they are secured by angle irons. Surface condensers are of course employed, but instead of using the water fresh, as it comes from the condensers, care is taken to add about seven ounces of salt water to the gallon, which causes a scale about the thickness of ordinary paper to form on the tubes and interior of the shells, and this prevents the corrosion which would destroy the surfaces, if unprotected from the copper salts dissolved by the water from the copper tubes of the condenser, the pipes, etc. The steam, before reaching the cylinders, is carried through a super-heater, situated in the uptake, and heated by the escaping gases from the furnaces. The workmanship seems to be very good throughout, and creditable to the makers, whose establishment in Copenhagen gives employment to about 1,100 operatives.

I was informed by the engineer on board the Thorvaldsen that Denmark is now building quite a number of iron steamers, some registering 1,000 tons, which, considering that this branch of industry was commenced in that country only some fifteen years ago, with boats of fifty tons for the Baltic trade, is a decided proof of progress. One iron vessel, smaller than the Thorvaldsen, but with engines of the same style and power, makes fourteen knots an hour, running between Copenhagen and Stettin. Another, the Dania, runs the distance, 104 miles, between Copenhagen and one of the towns in Jutland, in eight hours. She has paddle-wheels, and oscillating compound engines, the high-pressure cylinder working within the low-pressure cylinder, and both fitted with suitable slide valves.

*A paper read before the Polytechnic Association of the American Institute, March 8th, 1872, by Prof. JAMES A. WHITNEY.

A Rich Mine.

According to late advices from Nevada, the principal mine of the Eureka Consolidated Company now presents a most favorable prospect. Within the past year Eureka has shown itself to be one of the richest mining districts in the State, and from the late developments in the mine alluded to, it is safe to say that the product of the district for next year will be largely increased.

It has been estimated that *twenty millions* dollars worth of ore are now to be seen above the two hundred and fifteen foot level. We are informed, also that, at a cost of sixty-five thousand dollars, a narrow gauge railway is to be built from the mine to the reduction works, and additional hoisting machinery put up. Two more fifty ton furnaces will be erected, and it is expected that the seven furnaces will then be able to smelt three hundred tons of ore per day.

Owing to the bad roads, five hundred tons of bullion, worth three hundred and eighty dollars per ton, are now accumulated.

THE ENGINEERING AND MINING JOURNAL.

ROSSITER W. RAYMOND, Ph. D.,
WILLARD P. WARD, M. E.
Editors.

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THE ENGINEERING AND MINING JOURNAL *is projected in the intent of furthering the best interests of the Engineering and Mining public, by giving wide circulation to original special contributions from the pens of the ablest men in the professions. The careful illustration of new machinery and engineering structures, together with a summary of mining news and market reports, will form a prominent feature of the publication.* It is the Organ of the American Institute of Mining Engineers, and is regularly received and read *by all the members and associates* of that large and powerful society, *the only one of the kind in this country.* It is therefore the best medium for advertising all kinds of machinery, tools and materials used by engineers or their employees.

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The Utah Silver Mining Company.

The London mining papers contain of late a good deal about the affairs of this company. From the proceedings of the January meeting of stockholders, it appears that the vendor's statement about the property was "highly colored," and that results have been disappointing—to wit: the expenditure of the entire working capital, and the creation of a debt of £8,000, unknown to the directors. This the meeting resolved to cover, and raise the necessary additional capital, by an increase of stock, four thousand new shares at £5 per share being allotted to the original shareholders, and another thousand shares, obtained by "pressure" from Mr. BATEMAN, the vendor, being distributed as bonus among the takers of the new stock. It is said that the money to pay liabilities, and an additional sum for working expenses has since been forwarded. Mr. J. R. MURPHY, it was announced, had been engaged to put the mines in paying condition by the end of February, at a salary of $1,000 per month if he succeeded, and $500 per month if he did not succeed. This gentleman telegraphed Feb'y 8: "Red Warrior 17 feet solid mineral, 40 feet deep, showing beyond expectation;" a statement which proves nothing; as the solidity of the mineral is no particular sign of its value, unless the species of mineral be given. The fact plainly appears, that this company is relying upon two things only: the hope of an improvement in the quality of its ore, and the skill of Mr. MURPHY as a miner and smelter.

With regard to the latter points, we have a little to say at present. Mr. MURPHY has written us a highly indignant letter, with reference to a recent communication from "A. E." in our columns, regarding the above company and its mines and furnaces at Bingham cañon. He pronounces the article a libelous slander, reflecting on his reputation. He "will not condescend to answer" its statements, because their falsehood is so apparent to everybody in Utah. He is going to deal with them in "a more practical manner," and wishes to draw the attention of our readers to the fact that "the slander, its cause and the actors are about to be duly vintilated, when the tens of thousands of patrons which it has been my province to serve within the past 14 years in the field of practical mining and metallurgy will be my reference, as against some three or four practical features, well known as such; and who latterly have assumed, or at least a portion of them, the character of blackmailers (proof to hand)."

We shall be quite ready to publish Mr. MURPHY's "vintilation," if it is properly revised as to grammar and spelling, and really pertinent to the questions referred to. Meanwhile, judging him by the evidence of the reports bearing his signature, we heartily agree with our contributor "A. E." that they are "not worth the paper they are written on." Illiterate, vague, illogical and absurd use of language is not conclusive evidence against a man's practical dexterity in a business with which he is acquainted, but it certainly is not evidence to his advantage. We have a prejudice in favor of education; mine-engineering and metallurgy are both, in our humble opinion, dependent to a considerable extent on the science of mechanics and chemistry; and a person who talks learnedly of "lime of the blue, soft, carboniferous variety," and ores of the "oxicarboniferous" class, or promulgates the novelty of salt as a flux, though he may be a great genius, is unfortunately making himself appear like a great fool. We do not purpose to investigate his qualifications or his career; it is not our business to hunt such game, large or small; but it is our business to criticize reports and statements offered to the public, and to comment upon transactions of a public character effected by means of them. Mr. MURPHY's incapacity in this department is matter of record, and the record is made by himself and signed with his name.

Crooked Ways.

Mr. CROOKES, whose accounts of experiments with the "Psychic Force" have been severely criticized at home and in this country, replies to a personal attack by Dr. CARPENTER, in a pamphlet which is attached to the last number of the Quarterly Journal of Science, of which Mr. CROOKES is editor. Dr. CARPENTER's article (published in the Quarterly Review) was certainly a savage assault; and the style of Mr. CROOKES' reply is calculated to win the sympathy of the reader. We have not entered the debate upon Psychic Force, and we do not care to express an opinion concerning the furious personalities into which it has degenerated. But we lost confidence in Mr. CROOKES a good while ago; and in this last vindication of himself he has repeated the offence which dishonored him then in the eyes of all who were familiar with the facts. These we shall briefly recapitulate.

1. The discovery of sodium-amalgam and its uses by Prof. HENRY WURTZ of this city, and his application for a patent for the invention, was swiftly followed by a similar invention by Mr. CROOKES, in London, which led to a discussion of the question of priority and originality.

2. In this discussion, all the dates of announcement, application, issuance of patent—in fact, the whole of the circumstantial evidence, was in favor of the American chemist. Mr. CROOKES was on the defensive throughout; he never breathed the suggestion that Prof. WURTZ got the idea from *him;* on the contrary, he attempted to remove the very natural suspicion that he received the hint of it, at least, from the American Patent Office, through some one of the spies, who, it is well known, make a business of sending to England information of new discoveries, to be patented there (according to the lovely British law) by the "introducer," without reference to original authorship. We repeat that Mr. CROOKES rested on his own solemn declaration that this was not the case with the sodium-amalgam patent; that the instance was one of independent, simultaneous discovery, not unknown in the history of science. This declaration of Mr. CROOKES was accepted, in view of his respectable standing, as conclusive; and certain curious coincidences between his specifications and the earliest papers filed at Washington by Prof. WURTZ, were ranked as accidental.

3. A year or two later, Mr. CROOKES published a translation of KERL's Metallurgy, and in the chapter on Silver, introduced a flattering description of CROOKES' Sodium-Amalgamation Process. No allusion whatever is made to Professor WURTZ in the book. This is brazen enough; but worse remains behind. A letter in the San Francisco *Mining and Scientific Press*; an address by Professor SILLIMAN before the National Academy of Science at Washington; an account of experiments at Tulare county, California, published in a San Francisco paper; and an account of experiments in Colorado, given in this paper (then the AMERICAN JOURNAL OF MINING) are all quoted as referring to CROOKES' process, whereas they all referred to the process patented in this country by Professor WURTZ. Some of these documents, indeed, contained his name, which Mr. CROOKES deliberately avoided quoting.

4. We branded this piece of dishonesty as it deserved, more than three years ago; and we have never seen or heard of any "vindication" from Mr. CROOKES. And now in his reply to Dr. CARPENTER, he proudly alludes to his discovery of sodium-amalgam, extensively used in Australia, *California*, etc., as one of his claims to the respect of scientific men. The psychic force of "a lie, well stuck to," is proverbial; but it will not work in this case, across the Atlantic Ocean. We do not accept any statements whatever, on the authority of Mr. CROOKES, until he has confessed and atoned for the outrage we have now for the second time exposed.

It is quite immaterial whether he did really discover sodium-amalgam; it is immaterial that the discovery is of no great practical value, and that the process is *not* in general use anywhere, and has long been abandoned in this country. Our charge is not against the originality or the value of Mr. CROOKES "invention;" it affects directly his conception of truthfulness and honor, his claims to belief as a witness and to respect as a man. According to our notions of the brotherhood of science, its members always confide in one another's sincerity and good faith. A person who cannot be trusted so far, is, *ipso facto*, not a member.

American Institute of Mining Engineers.

OFFICIAL BULLETIN.

Announcements to Members and Associates.

I. It is believed that several names of members and associates elected at the Bethlehem meeting in August, 1871, have been accidently omitted by reason of the loss of a portion of the records of that meeting. Such persons, or their friends, are requested to communicate with the Secretary.

II. All members and associates who have not paid

their dues are requested to do so at once, by sending in postal orders, or check, or money, ten dollars to the Secretary.

All members and associates who pay their dues for each current year, strictly in advance, will have sent to their address, regularly and weekly, the ENGINEERING AND MINING JOURNAL, which is the organ of the Institute, and will contain the proceedings and transactions, and all important papers read before the Institute, and all notices of meetings. Back numbers cannot, as a general rule, be sent.

III. It is expected that the more important papers read before the Institute, and the debates thereon, will be published in annual or semi-annual volumes to which those members and associates will be entitled who have paid their dues.

IV. Authors of papers are requested to notify the Secretary in advance of the meetings, giving the subject and length of their papers. Attention is also called, in this connection, to Rules 12 and 13.

MARTIN CORYELL, Secretary. Wilkesbarre, Pa.

About-Town Jottings.

The statement in the N. Y. *Standard* of March 22d, that the pier of the Brooklyn Bridge had sunk, is false in every particular. Less than two weeks ago accurate surveys showed that perfect levels have been maintained from the base upward. Cheap papers have to *make* sensations.

BUSINESS AND PERSONAL.

Personal announcements and business notices, inserted in this column, at fifty cents per line.

Geo. F. Blake & Co., 79 Liberty street, Steam Pumps of every size and capacity, for all purposes.

Utica Steam Engine Co. (formerly Wood & Mann Steam Engine Co.,) 42 Cortlandt street, N. Y.

Post & Goddard have removed to No. 111 Liberty street. Dealers in Taps, Dies, Reamers, Drills and supplies generally.

Peteler Portable R. R. Tracks and Cars. Miners and contractors, send for circulars, 42 Broadway, N. Y.

American Submerged Pump. Power attachment—cheapest and best in the market, 55 Chambers street, N. Y.

Roper Caloric or Hot Air Engine, 124 Chambers St.

Blake Bros., New Haven, Conn., manufacture Stone Breaker for crushing ores and minerals of every kind into small fragments, preparatory to their further comminution by other machinery.

The Method of Mining the Hard Ores (Specular and Magnetic) now Practiced in the Marquette Iron Region.

*BY MAJOR T. B. BROOKS.

The iron ores of the Marquette region are mostly extracted in open excavations; hence the process is more properly quarrying. Several attempts at underground work have been made, which have not, on the whole, been successful. The Edward Mine has been almost entirely wrought by candle-light. The slate ore pit, No. 1 of the New England Mine, is now worked in the same way, as is also the Pioneer furnace pit of the Jackson Mine.

The Champion Mine was opened systematically for underground work, with two levels, 60 feet apart, and three shafts at distances apart along the bed of 200 feet; but this idea has been practically abandoned, the greater part of the ore in that mine now being taken out in open pits.

Several other mines have occasionally worked underground stopes, but only temporarily; if such stopes could not be opened out to daylight, they have usually been abandoned. In brief, it may be said that no considerable amount of ore has as yet (1870) been mined underground in the region, and of that so mined very little has been taken out at a profit, and I may add that it seems to be the belief of the most experienced mining men that this state of things will hold for some time to come for reasons which will appear.

Nearly the same remarks may be applied to the mines of the Iron Mountain region, Missouri, the ores of which are very similar in character to those of Marquette. Some of the New York and New Jersey magnetic deposits are wrought open, but this is the exception, underground mining being the rule.

The following brief sketch of the geological structure of the Marquette iron deposits will indicate some advantages of the method of mining employed. The iron bearing or Huronian series of rocks, are stratified beds, the principal ore formation being overlayed by a quartzite, and underlayed by a diorite, or greenstone. This ore formation is made up, first, of pure ore; second, of "mixed ore" (*i. e.*, banded jasper and ore); and third, a soft, greenish schistose, or slaty rock (probably magnesian), which occurs in lens-shaped beds which alternate with ore, thus often dividing the formation into two or more beds of ore, separated by rock. Usually the beds of both ore and rock thin out as they are followed from a centre of maximum thickness, producing irregular lentiform masses. Since its original deposition, if we may assume they were laid down under water, the whole series, including the iron beds, has been bent, folded and corrugated into irregular troughs, basins and domes, which often present at the surface their upturned edges of pure ore, standing nearly vertical. A cross section, finely illustrating this structure, can be seen on the west side of the great southwest opening of the Lake Superior Mine. It is locally known as the "Big W," which letter is plainly suggested by the sharp folding of rock and ore.

This structure involving sudden changes in the amount and direction of the dip, from horizontal to vertical, would evidently necessitate in the case of underground work constant changes in the plan of attacking the ore, as well as in the mode of supporting the roof.

The magnetic iron deposits in the Eastern States may also be regarded as true beds, but are far more regular in strike and dip, extending downward at a high angle to an undetermined depth, and appearing more like veins. If folds exist, they are much deeper and more regular than in the deposits under consideration. The Marquette ore deposits are often very thick, 50 feet being not infrequent, which makes ordinary timbering difficult, if not practically impossible; while the Eastern deposits, so far as my observations have extended, are seldom over 20 feet and average considerable less than that thickness.

The "pinch and shoot" structure suggesting what are termed "chimneys" in some metalliferous mines, and which is very apparent in the New York and New Jersey mines (practically dividing the ore into pod shaped masses, the axes of which "pitch" in the planes of stratification in a direction quite different from the dip) has not yet been observed in the Marquette Region; but greater depth may reveal it. The intervening barren streaks where the hanging and foot walls come near together, and which therefore divide the shoots, form excellent supports to the overlying rocks, and give the mine great security, as all who have mined the New Jersey magnetic ores will testify.

The soft schist mentioned as occasionally bedded with the Marquette ore, often constitutes the hanging wall in parts of the mine, but does not possess the requisite strength to make a good roof. It is impossible to support such rock with occasional timbers or pillars, for it will scale off between the supports, demoralizing the men, if not actually endangering their lives. Even when the works reach the solid quartzite, which, as has been stated, is the true overlying rock of the ore formation, it is sometimes not safe, particularly near the surface. These facts make open workings a practical necessity at the start, and the great economy of breaking ore from high stopes with heavy charges of powder, induces a continuation of the method even where the rock covering has attained a thickness of many yards, and underground work would seem to be advisable. It is indeed hard to say what thickness of solid rock a Marquette mine-superintendent would hesitate to remove if it covered a large deposit of ore. Forty feet of the earth and nearly as many of quartzite (as hard as granite) have been "stripped," and the thickness of rock is daily growing greater as the beds of ore are followed in depth.

It may be said, and I do not know but that it is a canon of mining, that all mines which sooner or later have to be wrought underground, should be systematically opened as mines at the start, but this is not Marquette practice; and I have undertaken to describe, and so far as I am justified, defend the methods there employed. It would be difficult to convince our people that having a large deposit of pure ore before them of unknown form and size, covered often by but little earth, and backed by, perhaps, a small amount of money in the company's treasury, it is best to incur the delay and cost, incident to sinking and drifting to open ground, thus already opened by nature and ready to win. Wrought as open quarries, several of our mines have paid their way from the start, while had they been opened in a regular system of mining, it would have required an investment of $50,000 in plant and improvements before shipments could have begun, and at least one years time. Such facts settle such questions with American capitalists, and with the uncertainties which attend the opening of new mines in new districts, the high rate of interest in this country and uncertainty of tariff legislature regarding iron, it may be a question whether this hand to mouth—quick return—let the future take care of itself—view of the question is not in a certain degree defensible.

The appearance of our mines is anything but pleasing. They consist of several (sometimes of ten or more) irregular elongated pits, often very large and generally more or less connected, having usually an easterly and westerly trend imposed by the strike of the rocks. Everywhere are great piles of waste earth and rock, which are often in the way of the miner and which in some instances have been handled over three times.

There are two principal advantages in open works. First—the preparatory work is all reduced to the simplest and safest kind of pick and shovel, hammer and drill, horse and cart business, such as can be let to the common run of mine contractors. On the other hand, underground mining involves sinking, drifting, timbering and elaborate machinery, all of which require skilled labor and large investments. In an isolated cold country like Marquette, the *quality* of the labor demanded is an important consideration. The second advantage already mentioned, is the great economy in cost of drilling and explosives which high stopes in open works permit. These elements of cost are important items in all mining when hard ores are encountered. It is believed that they have been reduced to a minimum in the Marquette iron mines; holes two inches in diameter are sometimes sunk 22 feet, and 15 feet is common. Such holes are not fired directly with the blasting charge, but are "shook" several times first, that is, fired with small charges which produce cracks and cavities about the bottom of the whole; when these are large enough to hold a sufficient amount of powder the lifting charge is put in, and the great mass thrown down. Twenty kegs of powder, of 25 pounds each, are sometimes fired at once, and from five to ten kegs is a common charge for a stope hole.

By this method five thousand tons of material have, in some instances, been removed at one blast and one-third of that amount is quite common at some of the mines. In this way the entire cost for labor of drilling and explosives, has been reduced for a single blast to less than three cents per ton. But the average cost is of course much greater, being at some of the mines 50 cents for all drilling and all powder consumed in the mine, about one-third of which is for block-holing the large masses thrown down by the stope holes, which are often so large that they have in turn to be broken by powder. The cost of powder and fuse for the hard ore mines, it is believed, does not exceed 10 cents per ton. In some of the New York and New Jersey mines which

*This paper was prepared over a year ago, as part of the author's Geological Report on the Iron Region of Lake Superior, and was read before the American Institute of Mining Engineers, at the Philadelphia meeting.

are worked underground I am informed that these items cost much more. In the Presberg mines, Sweden, the drilling and explosives cost 65 cents per ton of ore in 1870. It may be inferred from the above description, that Marquette iron mining does not differ essentially from ordinary rock excavation on public works, being work that may be let by the cubic yard or ton to the common run of contractors. Until quite recently this has been very near the truth, the difference being in the skill and care required in separating the ore and rock which are often mixed together in the mine. But these palmy days are rapidly passing for most of the mines now worked. An increase of water and greater cost of handling incident to increased depth, and, what is still more costly, the increase in thickness of the rock covering will soon require, in fact does now really require, more expensive plants, different methods and more skill.

The transition from the present system of quarrying to the future method of underground mining, which will have to be made in the Marquette Region, will be a critical period, and will present great interest as affording a solution of a mining problem, such as may not yet have been presented anywhere. Attempts at its solution have already been made, but, as has been remarked, very little ore has as yet been extracted at a profit by candle-light. To recapitulate; the system adopted will have to meet the case, 1st, of beds of ore, varying, often abruptly, in thickness from 0 to 50 feet. 2d, of beds varying in dip from nearly vertical to horizontal, and passing by a curve of small radius from one inclination to an other; 3d, of beds varying in character of hanging wall from a solid quartzite, which will stand with ordinary supports, to a soft schist, which can only be kept in place by a connected support, or actually filling in—"remblais." Again, the axes of the folds are not horizontal, but sometimes "pitch" at angles of 30 degs. or more in the direction of the strike, producing a fourth troublesome feature. Now, when we consider that the dressed ore is expected to yield 65 per cent. in the furnace, and is not worth at this time (1870) on the average over $4 per gross ton on the cars at the mine, including royalty, the general character of the problem will be understood.

In New Jersey, with perfect regularity in the dip, better hanging walls, thickness within the limits of easy timbering, cheaper fuel and labor, and an ore which breaks easier than those of Lake Superior, the ores of several well-known mines, I am told, cost fully this amount.

Steam machinery for hoisting and pumping, which has cost from six to not less than fifty thousand dollars has been erected at ten out of the thirteen mines in the Region, and one of the exceptions, the Washington, has driven an expensive tunnel in order to do away with the necessity of engines, which has cost as much as a heavy plant of pumping and winding machinery. At the present time (1870) not much more than one half of the entire ore product of the Region is handled by steam, and much less than this proportion of all the material, the balance of this kind of work being done by horses. From this it may be inferred that while the cost of breaking ore may have been reduced to a minimum, by the system of mining employed, not much can be said in favor of the methods of handling the ore from the miner's hands to the cars. The expensive horse and cart, swing derrick and whim, are in too general use, and the roads over which the loads are hauled, are often not above criticism as to grades and surface.

In order to more intelligently follow the methods of working the Marquette mines, we must classify the various items of cost under appropriate heads, and assume some absolute cost per gross ton, as near the actual fact as possible, as a basis of comparison of these items with each other, and with other mining regions.

No discussion of the question which leaves out the cost, would possess much practical interest; but, all who have undertaken to obtain such costs for publication, know the difficulty, and will form their own judgement as to the accuracy of what follows. $2.64 per gross ton will be assumed as the entire cost of mining the hard ore and delivering it in the cars ready for shipment; but this sum does not include interest on capital, expense of selling, royalty or mine rent, nor depreciation of the mining property. Nor is it given as the average of all the mines, or of any particular mine or mines. Some have exceeded this cost, others fallen short.

Before dismissing the subject of *mine rent* or *royalty*, which does not appear in this estimate, I will make a few remarks. Marquette mines are generally owned and worked by the same parties, hence royalty does not enter directly as an item of cost, but it exists in substance, and may be called *depreciation of the mine*, an item in the cost of ore often not sufficiently considered. One of the best organized and successfully operated iron companies in eastern Pennsylvania place this item at fifty cents per ton of ore. That is to say, every ton of ore sent from a New Jersey mine (which they own) is charged with fifty cents over and above its cost, as shown by the mine accounts, and a like sum is credited to the capital stock account or to a sinking fund. This fifty cents stands for the original cost of the ore, and is all the more real, that it was paid in advance in the price of property and improvements. Any mining company which fails to recognize this principle is doomed some day to serious disappointment. Whoever has had experience with charcoal blast furnaces, which so rapidly sink their capital, will be fully alive to the importance of this matter. It is a delusion to suppose that our mines will not eventually be exhausted; iron ores do not grow; a ton shipped from a mine is gone forever, and the property has one ton less remaining, and is therefore worth less money. Continued shipments will eventually exhaust any and all mines. Abandoned pits, in which no ore can be found, now exist at all of our mines, and in this class are some, that two years ago were the best. The Andover Mine, New Jersey, once presented as good opportunity to break ore, as any pit now worked in the Marquette Region; but about 150,000 tons aggregate product exhausted the mine, and today the owners do not know where to find a ton of merchantable ore on the property. I do not wish to be understood as predicting the exhaustion of the whole region; I think Marquette will produce iron as long as that article is wanted. New deposits of rich ore will be found, and leaner ones which now have no value will be worked; the old deposits will be followed deeper; but this implies new mines, the building up of new locations, new railroads, new men and more capital. What I wish to say is, that unless present holders of average Lake Superior iron mining stocks are receiving fair interest on their investments, and in addition are being paid back the capital they have invested, at the rate of, say, fifty cents per ton of ore sold, they are not doing a good business.

Therefore the $2 64 assumed above should be increased by this amount, making it $3 14. Commission for selling, interest and exchange, insurance and expenses of the general office of the Company (including salaries), will increase this sum to at least $3 50, which will more truly represent the actual cost per gross ton of ore on cars and sold. This, from the amount assumed before as selling price, leaves 50 cents per ton for interest on all fixed capital invested.

There may be no better place than in this connection, to speak of another fruitful source of the disappointments which are sometimes experienced by stockholders. I refer to those delusive "permanent improvement accounts," better named permanent disappointment accounts, which are too often kept open, and in which are too frequently placed awkward sums which should properly go to running expenses, and be paid for by the pig iron, ore, lumber, or whatever is produced. After the necessary real estate is bought, the mining or manufacturing plant built and the business of production actually commenced the improvement account should be closed for ever. Some kinds of business, in some places, under some managements, may permit an opposite course, but the above is the only safe rule. If in any particular year an extraordinary expenditure is made which is not likely to be repeated, a part of it may properly be held in some open account, in order that it may be distributed over more than one year's product. But this is a different thing from piling up a permanent account under the usual delusion that the property is enhancing in value.

There are few kinds of business in which there is more danger from this cause than in iron mining, for not only is an iron-ore property depreciating from the exhaustion of the ore, but at any time it may be still more depreciated by unfriendly tariff legislation for which the ironmaster must be prepared.

To return to our subject, the mining work and costs sketched above, amounting to $2 64, may be conveniently classified under the following five heads:

1st. *Dead Work*, or all that is preparatory to getting ore. This includes finding the ore, making all roads, shafts, drifts, &c., which will enable the miner to attack it, removing the earth and rock covering, together with such improvements and appliances as may be necessary from time to time for the proper handling of the ore, or conveying it from the miners' hands to the cars. Rock and earth excavation is all done by the cubic yard or fathom, the contractor often finding his own teams. Shafts and drifts are always done by contract. This dead work, according to our estimate, costs 74 cents per ton, equal to 28 per cent of the whole cost of the ore. I estimate that about 62 cents is for labor, and about 12 cents is for supplies of various kinds.

2d. *Mining proper*, locally termed "breaking ore." This embraces all drilling and blasting, sledging, sorting out rock, and loading the rock and ore into the vehicle which is to carry it away. This labor is almost entirely performed by contract, the contractors being paid from 60 cents to $1.60 per ton of ore with sometimes an allowance per ton for rock. The contractors find their own powder and fuse, and pay for the use of tools. Such contracts are sometimes let to one man who hires his own help, but the common way is to give the job to a party of men jointly; a new price is often made each month. In a few instances contractors take long jobs, do their own stripping, breaking the ore and delivering it in the cars. $1.05 is the estimated cost of this part which is all labor; it equals 40 per cent of the whole, and is the largest single item. The fact that the cost of this work varies so widely in different parts of the same mine, and in the same part at different times, makes organized strikes difficult. There can be no common grievance, no watchword. One "pair" (two or more men working in common) may be losing money at 75 cents per ton and be disposed to strike, but their neighbors who are receiving $1 in their pit are making money and have no sympathy with the strikers. Usually the unfortunate "pair" stick it out until the end of the month, and then get a better price or go away.

3d. *Mining material* and implements. The items embraced here may be sub-divided into explosives, tools and repairs: the miners term "mine-costs," embracing them wholly or in part. As has been stated, miners working on contract have to pay their own "mine-costs," which amount is usually from 13 to 17 per cent. of the whole amount they receive for their work. About 31 cents per ton, or 12 per cent. of the whole is regarded as the cost incurred under this head, 10 cents of which is for labor, chiefly of blacksmiths, and about 21 cents for supplies.

4th. *Handling* the ore from the miners' hands to the cars, and freeing the mine from water. As has been stated, mining contracts usually go no further than to load the ore in the cart or bucket; all the

costs from this stage to the cars are embraced here as well as the pumping, which is usually performed by the same machinery that hoists, hence cannot be well separated. Until recently no pumping has been necessary, and the handling was done by horse and cart. It is estimated that this work heretofore cost over 41 cents per ton, or say 16 per cent of the whole. About 27 cents of this would be labor, largely of drivers, and 14 cents supplies in which forage is by far the largest element.

5th. *Local management*, office expenses, taxes, &c. This is not intended to include the selling of ore, nor salaries of officers who do not reside in the mining region. About 12 cents per ton or less than 5 per cent. of the whole cost is placed opposite this item, over one-half of which would be salaries.

MINING SUMMARY.

Nevada.

We are indebted to the Gold Hill *News* of Feb. 3 for the following mining items.

The Crown Point mine is now looking better than ever before, with more and richer ore in sight. In fact, the more the great ore body is prospected and developed the more extensive it is found to be. It is estimated that between forty and fifty million dollars worth of ore is now in sight in the Crown Point and Belcher mines, constituting the richest and best ore body known of in the world. The cross-cut at the 1,200 foot level of the Crown Point is now in 120 feet, all the way in rich ore, and the full width of the body not attained yet. The assays at that level average about $550 per ton. When the two new hoisting engines are placed in working position and all other arrangements made to correspond, an increased force of miners will be put to work and 600 tons per day will be the regular product of the mine. The Belcher is in a similar flourishing condition, and being worked with great energy and efficiency. The ore body is found to continue south to an unknown extent, the main drift in that direction at the 1100 foot level being in over 350 feet from the Crown Point line, and the face of it still in fine ore. The retimbering of the main shaft is nearly completed to the surface, and the incline from its bottom is down nearly 200 feet, the face showing quartz with spots of ore. Good ore is reported to be found at the 1400 foot level of Savage mine, south of the shaft. Whether it prove to be of any extent or not, it is a very important and encouraging indication at that depth. Three hundred and thirty-one tons of ore were extracted last week from this mine, of the average assay value of $35.36 per ton. The new strike it is said, looks well and promises to develop into a good sized body. Six hundred and ninety tons of ore was extracted from the HALE & NORCROSS mine last week. The Gould & Curry mine is yielding little ore at present, no new bodies being developed, although a great deal of prospecting is being done. The main shaft is 1500 feet deep, perpendicularly, or 1700 feet below the level of the Comstock croppings, being within only about 200 feet of the level of where the Sutro Tunnel proposes to intersect the lode. The assessment of $15 per share just levied aggregates $72,000. The new shaft of the Ophir is 1250 feet deep, and further sinking is discontinued at present. Drifting west for the ledge at the 1100 foot level is being vigorously prosecuted with excellent indications. The new shaft of the Overman Company is down over 300 feet, and at the surface a new and very powerful pumping engine is being put in position which will be of capacity to work 2,000 feet in depth. The Calendonia new shaft is down 500 feet, and at 600 a drift will be run to the lead. The prospecting developments in the Daney mine are energetically progressing as usual. The Company levied an assesment of 75 cents per share yesterday. In the shaft of the Julia mine a streak deposit assaying $17 in gold and $60 in silver is found 115 feet below the surface. The Company are still sinking and at the depth of 1,100 feet will drift for their main vein.

The mill at Rye Patch, burnt down last fall, has since been rebuilt, and is now running 15 stamps, having capacity for five more, hereafter to be added. The destruction of the old mill proved a great detriment to the mining interest in the neighborhood, bringing operations, which had become quite thrifty, for the time being to a stand still. With the starting up of the new works, business has revived and things again look cheerful about Rye Patch.

The mill and smelting works at Oreana, built several years ago, but which have never yet accomplished much —halting now, and then getting on with a hobbling gait —having lately passed into more competent, or, at least more fortunate hands, have been put in an efficient condition, and are likely hereafter to fulfill another purpose than that of drawing drafts on San Francisco to keep them going. Considerable shipments of bullion are now being made, which the proprietors believe they can keep up and somewhat increase. The mill is run chiefly on ores from the Montezuma, Brazil, and other mines in the Arabia District, close at hand.

Across the broad valley lying east of here, towers a broken and timberless range of mountains. Along its slopes toward the north were organized several mining districts in the early days. The good mineral indications abounding there, enticed many silver hunters into that region. They toiled diligently but their rewards came slow, or more often failed altogether. . . . . One set of prospectors was succeeded by another, the country now being thronged with adventurers and again quite deserted. . . . . At Dun Glen a mill has been built, and is running with a success not heretofore achieved in those mountains, the favorable results attained being largely due to the employment of the Paul Electro Amalgamating Process, which is accomplishing real wonders. Nothing directed to the effecting the ends especially proposed to be secured by this process—the speedy, thorough and economical separation of the precious metals from base combinations has yet done its work so well. As this invention is particularly well suited to the treatment of Humboldt ore, is portable and inexpensive, it will probably soon be introduced into general use in this region.

The principal mines now being worked in and about Dun Glen, the centre of greatest activity in the East Range, are the Tallulah, formerly under the superintendence of the lamented JAMES A. BANKS, now extensively opened and fast developing into a valuable property; the Lang Syne, affording ores for the new mill, the Peabody, the Cumberland, and a few others of less distinction.

DISTRICTS.

In the Central District, lying seven miles north of the railroad, opposite Raspberry Station, there are some twenty or thirty mines working away quite independent of capitalists. These men mostly own in the claims they are prospecting from which enough ore is extracted in process of development to defray all expenses. They generally explore their lodes by means of shafts carried down in the vein-matter, nearly all of which affords more or less ore. Selecting from this ore a small portion of the best, it is sent over the railroad to Reno and San Francisco for sale, netting them from three to five hundred dollars per ton. There is talk of a mill going up on the river, near these mines, in the spring.

In Winnemucca District, occupying the southerly face of a high, isolated mountain, ten miles east of Central District, there is about the same amount of population as in the latter, the miners conducting affairs much after the same style in both. There is a five-stamp mill here, the capacity of which is soon to be doubled, with a roasting furnace or a Paul Amalgamator added, the ores in this section, a mixture of sulphides, chlorides and galena, with often a sprinkling of free gold super-added, rendering some such course of treatment necessary.

In the Galena and Battle Mountain Districts, situate in the eastern part of the county, mining is prosperous; large quantities of argentiferous galena and copper ore, with a considerable amount of silver bullion, silver-lead bars, etc., being shipped from that neighborhood continually. In the Pueblo District, lying in the extreme north-western corner and also in various other parts of the county, mining for silver and copper is being prosecuted, to a greater or less extent, and with results not in the main differing much from those above mentioned; a glance over the whole country showing this pursuit to be not only moderately progressive but growing all the while more self-reliant and self-sustaining.

RAILROAD SYSTEMS AND PROJECTS.

The construction of a narrow gauge railroad from Mill City on the Central Pacific to this place has engaged the attention of the people in this vicinity a good deal of late. The main trunk would be eighteen miles long, with a branch to Star City six miles long. The country to be passed over consists of an open sage plain, unobstructed by a tree or stone, and without a creek or ravine to be crossed. It could therefore be built cheaply, and with the already considerable and prospectively large amount of business to be done, offers good inducements for the right kind of parties to take hold of it. The valley through which it would lead is flanked with metalliferous mountains on either hand, guaranteeing some immediate and very soon a large revenue. As the mines south of here are opened up, the road could be extended in that direction thirty miles further, still striking a good mineral region.

THE SAVAGE STRIKE.

The Virginia *Enterprise* of Feb. 8 describes the first visit to the Savage Mine after the recent strike at the 1,400 feet level. We make the following extracts from this interesting article:

DOWN THE INCLINE.

Upon landing at the bottom of the shaft we were furnished with candles, and then marched Indian file eastward along a tunnel a distance of something over a hundred feet. Here we reached the incline, which runs down the main shaft eastward at an angle of thirty-eight degrees. In this incline, which is spacious and most substantially timbered, is on one side a car track and on the other the pump column and a flight of steps. Single file we descended the stairs a distance of 170 feet. This brought us to a drift opening on the south side of the incline and to the now famous 1,400-foot level, where centre the hopes and fears of so many persons on the Pacific coast.

THE NEW DEVELOPMENT.

Stepping from the incline into the mouth of the drift last mentioned, we advanced along it south, 29 degrees east, a distance of 100 feet, and before us was the spot in which the new deposit of ore has been found. Some workmen were engaged in extending the drifts still further to the southward, while on our right, or to the west, a cross-cut about 25 feet in length had been made. In this cross-cut, in but a short distance from the drift, is that part of the new body which contains the rich black sulphuret ore which appears to be the centre and heart of the new development. It is from four to six feet in width, and is filled with streaks and bunches of rich black sulphuret ore. On each side of this central streak there is good ore for some feet, but going west it gradually diminishes in richness, till at the end of the cross-cut it is of little or no value; to the eastward it seems to taper off much in the same way, though in that direction no cross-cut from the drift has been made. Altogether there may be said to be a width of about 20 feet of ore, the richest of which is the part containing the black sulphuret rock. They seem to have struck upon the north end of a body of ore which is opening out to the southward. The first traces of pay-ore are found in the drift back to the northward, near 30 feet from the cross-cut, and the appearance of the rock steadily improved to where the cross-cut west was made. In examining this cross-cut at the point where it passes through the black sulphuret section more good ore will be found on the south than on the north side. Thus far all the openings that have been made into the deposit are the drift running south and the cross-cut from it to the west. What may be ten feet ahead in any direction no one can tell; but there is every indication that in going that far south still fine ore would be found. The new development cheers, encourages, and gives new life to all the mining companies at work upon this end of the great lode.

STILL ANOTHER LEVEL.

From the 1,400-foot level the incline is being vigorously pushed on down, and is now within 50 feet of the point where another level—the 1,500—will be opened. At this great depth no water is found; indeed, instead of pumping, the little water found above is from time to time run down the pump column to the end of the incline for use in blasting. The quantity thus sent down serves to make it somewhat slushy at the bottom of the incline, and the surplus is sent up by the car—it amounts to so little.

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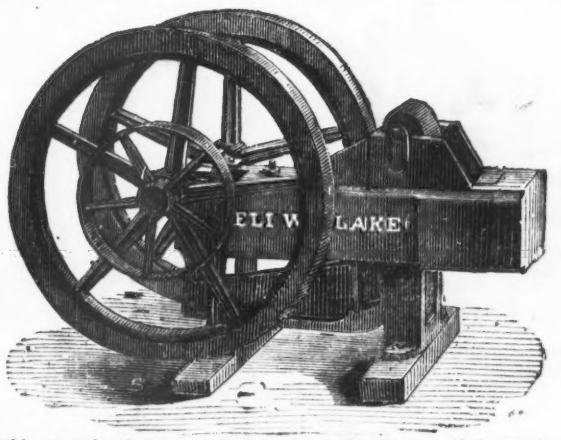

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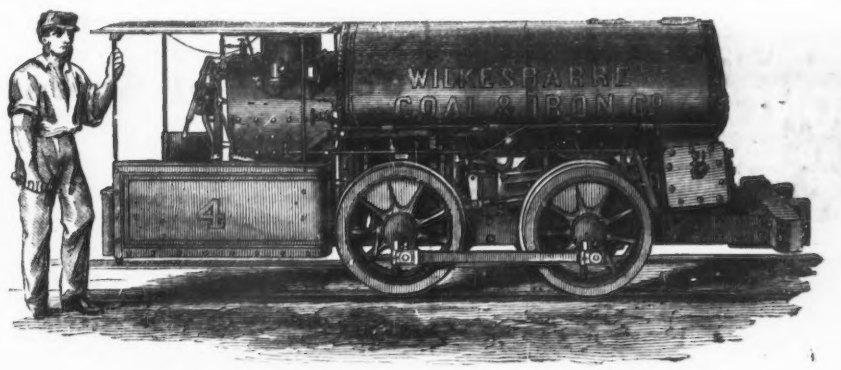

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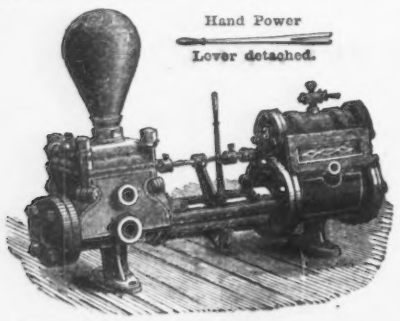

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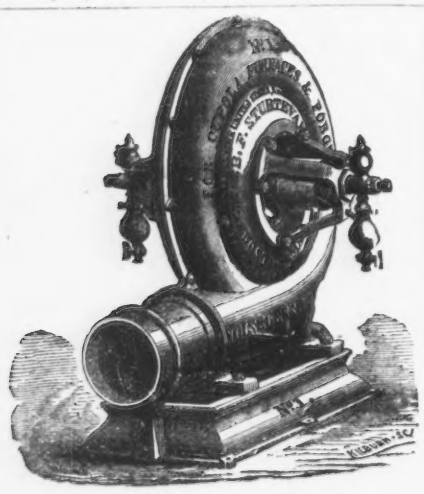

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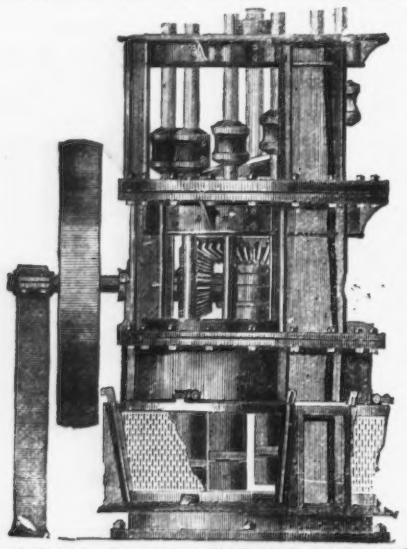

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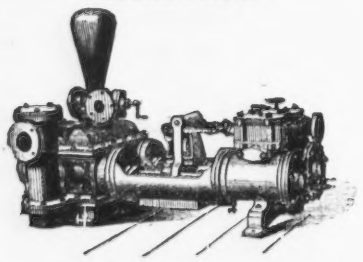

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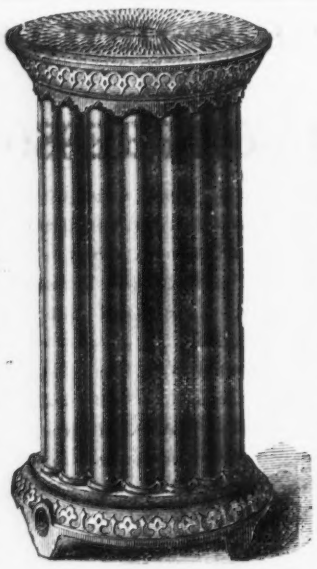

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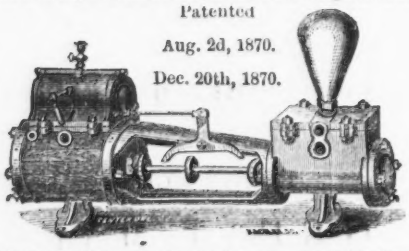

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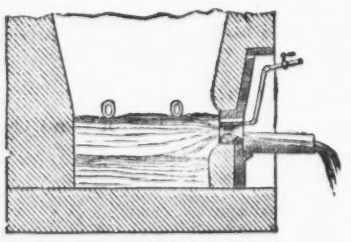

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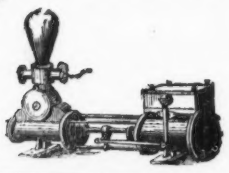

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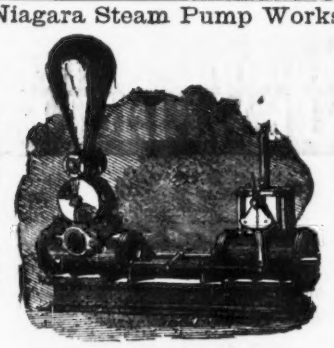

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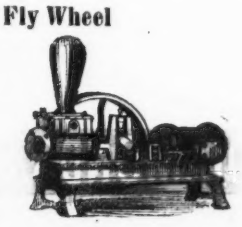

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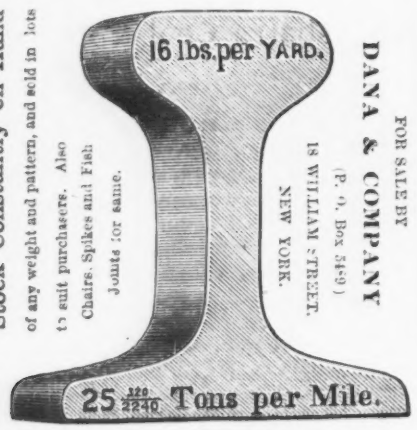

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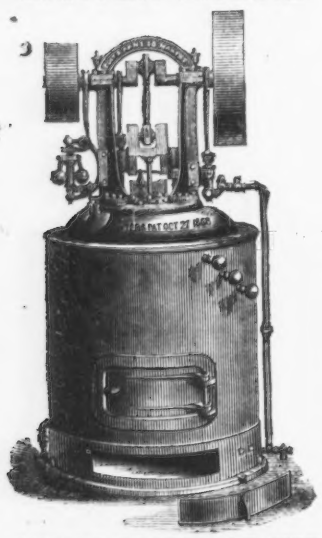

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